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# AGRICULTURAL JOURNAL

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## EDITORIAL.

IN this number of the Journal Mr. B. E. V. Parham contributes an interesting and important article dealing with disease in the yangona crop which is found growing in many small areas adjacent to Suva.

The yangona plant and some of its varieties are described and details are given of a general survey made with reference to the incidence of disease which shows that some 2,000 acres are under the crop in the Suva district.

The probable source of the disease is traced, its nature is outlined and its present incidence is described as well as its effect on the plants while the seriousness of the disease is emphasised in discussing the economics of the crop as affecting the Indian small holder.

Practical measures of control are indicated and inspections are shown to have been inaugurated with a view to the eradication and destruction of diseased plants, a matter fraught with much difficulty in the wet weather which has been experienced during the last half-year.

A short article dealing with a method of preparing copra along the lines generally adopted in the Far East is included in this issue as an indication of the possibilities of improvement of the quality of the commodity as produced in this Colony at the present time.

The continuously inclement weather which has prevailed during the past six months stresses the advisability of utilising artificial drying methods provided that they can be applied economically and it is claimed that the simple type of kiln described in this article should supply an outstanding need in this Colony.

The first of a series of articles dealing with the soils of Fiji, as far as present investigations have been carried, is contributed by Mr. Blackie who indicates briefly the methods in general use in the examination of soils by the Chemical Division of the Department of Agriculture.

In addition, the same author describes the composition of the alluvial soil found over most of the Central Agricultural Station and indicates that, though it is difficult to work under certain weather conditions, it is a soil of fair average fertility.

A résumé of the work of the Entomological Division of the Department should prove interesting reading especially to those who still recollect the ravages caused by pests in the main coconut areas. The work, briefly narrated, definitely shows that valuable results have accrued as a result of the many investigations made into means of checking the major pests of Fiji and reflect much credit on the investigators enumerated in the text.

The Veterinary and Entomological notes touch lightly on several matters of practical importance so that they should prove of particular interest to readers.

The Government Entomologist makes brief mention of two common fruit flies found in Fiji and of the economic possibilities of the distribution of a parasite which was recently introduced from West Africa by way of Hawaii, as a means of reducing fruit fly attacks on citrus fruits grown in this Colony.

The economic potentialities of the mahogany tree in Fiji are stressed in a short note based on reports, emanating from London, on a sample of timber of this tree grown locally and should prove worthy of notice.

An interesting note regarding certain incompatibilities in citrus stocks is contributed by Mr. Surridge as indicative of the interest which is now being taken in this particular crop which should prove remunerative now that good stocks of approved strains are available within the Colony principally to develop planting material for general distribution.

The exhibit staged by the Department of Agriculture at the recent Fiji Show is briefly described. The description indicates the comprehensive nature of the exhibit and the amount of work involved by the staff in staging it.

## WILT DISEASE OF "YANGONA."

By

B. E. V. PARHAM, M.A.
Assistant Agricultural Officer (Pathology).

DURING the past two or three years losses due to disease in the yangona crop (*Macropiper methysticum*) have caused increasing concern among growers and land holders in the Suva–Rewa districts. The search for a good cash crop which might produce a fair return within four or five years has led many growers to take up land in this area for the purpose of growing yangona. The result has been a very great increase in the extent of yangona cultivation in this part of Viti Levu. The spread of disease has, however, been marked and in view of the value of this crop, the following observations are placed on record—following a detailed survey of the affected areas.

### THE PLANT AND ITS VARIETIES.

The yangona plant is a robust somewhat succulent shrub, frequently attaining a height of 10–12 feet. The stems arise from the crown at ground level, and in the early stages are branched; but as the stem matures the lateral branches fall off leaving the characteristic nodal scars, so that at maturity the plant appears to consist of a number (10–20) of separate unbranches stems, arising from an extensive base or crown. The leaves are simple, cordate, entire, green or tinged with purple and are also caducous in acropetal succession. Flowers are rarely if ever to be found.

The underground portion of the plant is usually swollen, semi-woody to succulent, giving off numerous lateral fibrous roots.

The portions of the plant of commercial value are:—

1. *Lewe-na* the thickened underground portions of stem and crown.
2. *Waka-na* the lateral roots and rootlets.
3. *Kasa* the nodes of the stems are sometimes peeled and sold mixed with "Lewena" as an adulteration.
4. Peelings of roots and stems have also been sold in the market at a cheap rate.

VARIETIES.

Seemann (1865) mentions six varieties of the plant; but up to the present only five have been found, two of which are not very common. These are:—

(*a*) *White varieties.*—(1) Kasa Leka; (2) Kasa Balavu (Yalu); (3) Qolobi.

(*b*) *Black varieties.*—(1) Kasa Leka; (2) Kasa Balavu.

These are distinguished mainly by their habit, by the length of the internodes (Kasa) and by the size of the leaf-scars.—

(1) *Kasa Leka (white).*—Stem about 1½–2 inches in diameter. Leaf scars broad (1 inch), close together, *i.e.*, internodes short (2–2½ inches long). Stem green speckled with transverse lenticels, very abundant.

(2) *Kasa Balavu.*—Stem slender 1½ inch at nodes, ¾ inch at internodes. Leaf scars—small depressed ½ inch in diameter, internodes long 5–10 inches. Stem pale green, lenticels linear, vertical dispersed.

3. *Qolobi.*—Stems more slender, only 1¼ inch at node, ¾–1 inch at internode. Leaf scars ½–¾ inch, internodes long 3½–4 inch. Stem green, lenticels few, punctate confined frequently to the upper portions of internodes. Ratio between diameter of node and internode very marked of order 1 : 2.

4. *Kasa Leka (Black).*—Stem green black, scar 1 inch diameter. Node /internode ratio 2 : 3. Internodes 3–5 inches long. Lenticels dispersed circular to transverse.

5. *Kasa Balavu (Black).*—Stems very slender, black. Internodes 9–12 inches or more in length, 1 inch diameter or less. Scar ½–¾ inch node/internode ration 2 : 3. Lenticels linear and vertical.

There seems little doubt but that the white varieties are the source of the best yangona, but they take longer to attain maturity. The black varieties are not favoured by the Fijians, and are said to give a poorer beverage, but owing to the fact that plants mature earlier they have been extensively grown by Indians and others in commercial plantations. Black yangona is said to mature (for market purposes) in two and a half to three years, whereas the white varieties cannot be dug before four years. Also there is a possibility that the black varieties are more resistant to disease although the evidence of field records is not definite on this point.

METHODS OF CULTIVATION.

Originally used only for Fijian ceremonial purposes the yangona plant was formerly grown in small plots or around native house foundations and received the greatest care. It was usual to plant the sets or "kasa" (*i.e.*, sections of mature stems bearing nodes) in nurseries first, the young plants being transplanted when a few inches high. This method is still practised commonly among the Fijians.

In commercial plantations, however, the usual procedure is to lay the sets in the prepared hills, cover them with a wisp of dry grass or leaves and allow them to shoot in situ. Some Indians do, however, occasionally plant out from nurseries.

Formerly being treated with special care in small isolated plots, the yangona has in recent years been subjected to the methods incident to mass production and large areas have been planted, especially by Indians and Chinese, in many cases without sufficient attention to soil or other requirements of the crop.

A rich soil and good drainage are essential. The land chosen is usually well drained hillside, preferably new land, and in the area under consideration the soil is frequently shallow and overlies soapstone. The best soil is the

black to chocolate-brown soil which naturally supports a fairly heavy jungle vegetation, the red lateritic soils being unsuitable. A great many yangona plots are at present planted on old banana lands or on land which has already borne one crop of yangona. If two successive crops are taken off the same land the second is very poor. Fallowing for three years or longer has been stated to give satisfactory results.

Land, after clearing of jungle, is ploughed or dug over with forks and the yangona planted in hills six feet apart, two or three sets to a hill. The land is kept free from weeds by constant cultivation or hoeing. The crop is finally weeded when three and a half years old after which nothing is done until the crop is harvested. Dalo (*Colocasia antiquorum*) is commonly interplanted with yangona during the first year.

### COST OF PRODUCTION.

The economics of the crop are not easy to assess definitely, but the following summary is made from much independent information. Usually the holding is worked by the owner (Indian) and his family who live on the land and require very little outside assistance. The actual costs in such a case are:—Initial outlay on 10-acre holding:—

| | |
|---|---|
| Payment to Fijian owners .. .. | £10–£20 |
| Deposit (Survey fees, &c.) .. .. | £10 |
| Clearing at £3 per acre.. .. .. | £30 |
| Rent at 10s. per acre .. .. .. | £5 per annum |

Thus, for a four year period the total actual cost of production is regarded to be £100 (£10 per acre). Initial outlay £50–£60, rent £20, labour £30.

The return in four years is expected to amount to £500-£600, giving an actual profit of £400–£500 on a 10 acre holding over the four year period.

Side line crops are grown which, after the first three months, are sufficient to keep the man and his family and pay for labour working on the yangona crop. The procedure with Punjabis (whose aim is to earn sufficient profit to return to India) is to take up the land and grow for four years to maturity, then sell out. The buyer assists with harvesting the crop and in return the vendor assists him to plant a second crop.

The following figures on production costs of a commercial plantation at Kandavu are of interest. The cost of production is placed at £30–£35 per acre for a four years crop and the yield should be 20 to 25 sacks per acre (140 lb at 8d. or £4 13s. 4d. per sack) *i.e.*, £93 per acre. A very good crop would give 30 sacks per acre and the fibrous roots (waka) should pay for the cost of digging and cleaning the crop. The best prices in 1933 for yangona were up to 1s. 4d. per lb.

Frequently, in good land, the yangona crop is interplanted with " dalo " during the first year, and the latter is stated to give a cash return (gross) of up to £35 per acre, which offsets the cost of the yangona crop (£30 per acre).

### VALUE OF CROP AND PROFITS DERIVABLE.

The value of yangona crops and holdings have been much affected during the past year by the adverse effect of disease and a poor market so that it is difficult to determine the profits derivable under more normal conditions.

It is stated on good authority that yangona in the field is worth £60 per acre whilst Chinese growers estimate that it costs £15 to £20 per acre to clear land and plant the crop.

Losses due to disease have been investigated and it is found that plantations are affected by disease at all stages, and that those which have been so seriously affected as to cause abandonment, involve a complete loss. In other cases, on the first signs of disease the crop is immediately dug

and sold, usually at a loss. It is definitely established that landholders are abandoning their plantations owing to disease, although they could still make a living by growing vegetables. For instance a 14 acre holding, formerly valued at £400–£500, is now estimated as valueless and has been abandoned.

MARKETING.

Yangona is prepared for the market by scraping or peeling the roots and underground basal parts and drying them in the sun. Diseased portions are usually cut out, but generally a good amount of the semi-decayed root may be seen on drying benches.

The market is a local one, the price being 6d. to 9d. per lb at the present time. The fibrous roots may fetch 3d. per lb one plant producing as much as seven pounds of these. A good root many produce 10 lb of "Lewena" the best quality yangona. In 1933, a bundle of "Wakana" the second quality, weighing 20 lb was worth 18s., but now fetches only 1s. 8d. In the same year the bark and scrapings giving a very inferior product were marketable at 6s. to 7s. per bag. The peeled nodes of the stem ("Kasa") have also been sold mixed with the proper root.

It is commonly stated that yangona made from diseased root is deleterious to health and that the selling price of yangona in the market has been affected by this as many growers mix the diseased root with the sound in order to dispose of it.

AREAS SURVEYED.

In the course of the survey the following areas were inspected carefully:—

(1) *Suva–Rewa Road.*—
  (*a*) Four-mile peg and through to Princes Road.
  (*b*) Kalabo village and environs.
  (*c*) Tamavua District.
  (*d*) Nine-mile peg and surrounding areas through to Princes Road (Kalabo Indian settlement).
  (*e*) All the area between Suva–Rewa Road and the sea coast.
(2) *Princes Road.*—All plantations on both sides of road to 13 mile peg.
(3) Naitasiri District and Indian plantations on Baulevu Road.
(4) Districts of Navuakece, Lomaivuna and Navuakese.
(5) Namosi Province and part of Serua.

In the Suva–Rewa Road districts 320 plantations were inspected, comprising an area of 1,288½ acres and these were certainly representative of that area. Of the holdings inspected 293 were Indian, 21 Chinese and six Fijian, all located along both roads and in the intervening areas. The following is a summary of the plantations recorded:—

| No. | Locality. | No. of holdings. | Area in acres. | | |
|---|---|---|---|---|---|
| | | | Total. | Killed by disease. | Damaged by disease. |
| 1 | 4-mile Suva–Rewa Road to Princess Road *via* Caubati .. .. .. | 46 | 157½ | 23 | Prevalent |
| 2 | Princes Road to 13-mile . .. .. | 29 | 157 | 32 | .. |
| 3 | Kalabo and Environs .. .. .. | 33 | 111½ | 54 | .. |
| 4 | Suva–Rewa Road Southwards .. .. | 56 | 104½ | 3 | 2 |
| 5 | 9th-mile areas .. .. .. .. | 73 | 404 | 74 | 77 |
| 6 | 4th-mile Suva–Rewa Road, West .. | 51 | 219 | 56 | 21 |
| 7 | Kalabo to 5-mile Princes Road. .. | 32 | 134 | 10 | 13 |
| | Total .. .. | 320 | 1,288½ | 252 | 113 |

It will be seen that plantations in all parts of the district were affected, that out of a total area of 1,288 acres at least 252 acres of yangona were destroyed and 113 acres recorded as more or less heavily diseased. This means that approximately 30 per cent. of established plantations are affected by disease, representing a monetary loss of something like £12,000.

It is significant that many small areas (from one to five square chains in extent were recorded as healthy, whereas in larger areas disease was invariably present, often to a marked degree. Over the whole area the Black types showed a slightly higher degree of resistance than the white varieties.

Particular note was taken of the alleged recovery of diseased plants. Frequently plants which have been killed back do shoot again from the diseased crown, but these secondary shoots are weak and unhealthy and do not persist. The percentage of such recoveries is certainly very small.

### OBSERVATIONS ON THE NATURE OF THE DISEASE.

There are two manifestations of the disease, and among growers there is some doubt as to which indicates the true nature of the disease. In young plants there is a collapse of the stem and definite wilting, in old plants the disease is most marked by a dying back of the stems from the apex. This latter condition has led to the supposition that the disease is one of ultimate branches and leaves, *i.e.*, a " dieback." Careful observations in the field, however, prove that this condition is secondary to the infection of the root stock and crown, and that the disease is a " wilt " caused by the cutting off of the water supply resulting in the subsequent failure of the leaves and ultimate shoots. Thus, in large plants, where the " dieback " condition is the most prominent external feature, the underground portion of the plant is found to be in an advanced stage of decay. In small plants, up to six months old the disease manifests itself definitely as a " wilt " disease, resulting in a loss of turgidity and the collapse of the stem at ground level. In such cases there is usually to be seen a black necrosis about ground level, possibly in cases indicating the infection centre of the pathogen.

The progress of the disease in the field is progressively eccentric, and on slopes frequently from higher ground to lower. The distribution of diseased areas is discontinuous, the demarkation being definite. For example, one side of a gully may be completely devastated and the other side remain quite healthy, the line of demarcation being the watercourse at the bottom.

In young plantations, the incidence of disease is frequently dispersed and sporadic, suggesting that it is carried in the planting sets. On careful inquiry it was found that the earliest and most diseased areas were those planted with sets obtained from Lami, where owing to the presence of disease, the price of planting material was lower than elsewhere. Many independent records were made of the facts (1) that the disease first appeared at Lami in a Chinese plantation; (Ching Chi) and (2) that the worst areas at the nine mile, Princes Road and elsewhere were those planted with sets from Lami. It is certain that the stems of diseased plants were and are being used for further plantings and that these stems are infected with the pathogen.

The disease is now well known to all Indian and Chinese growers throughout the area under discussion, but no record of its appearance earlier than 1932–33 could be found. Many Indian growers were found on being visited a second time to be voluntarily removing and destroying diseased plants as advised.

Careful note was made of the soil type, drainage and related factors which might have a bearing on the incidence of disease. The growth of plants is certainly retarded in poor soils, but the disease was as prevalent in the best soils as in the poorer soils. The wilting of young plants was commonly quite severe in newly cleared forest soils where the growth of healthy plants was exceptionally good. The yangona planted on the shallow soils, often in beds heaped up on the bedrock, is usually stunted in growth but not more subject to disease. The ecological conditions most suitable for this crop do not appear to have been studied, as from the history of its cultivation it is obviously particular in its soil and climatic requirements and not adapted to the extreme conditions of open cultivation. The growing of yangona in pure stands of extensive area provides the optimum conditions for the development of disease and for its subsequent rapid spread.

## CAUSE OF THE DISEASE.

Further studies of diseased material have indicated that the primary cause is a wilt producing bacterium. Apart from the cultural evidence, the disease has many characteristics of a bacterial wilt, the pathogen being capable of living in the soil, in which case the *Fusarium* and *Neocosmopara* also recorded would be secondary and possibly saprophytic in nature. This essential point is being studied further as also the method of infection and whether the pathogen is a wound parasite or otherwise.

## CONTROL MEASURES.

Possible control measures have already been indicated, and the fuller survey of the affected area only emphasises the necessity for them. From an agricultural and plant-pathological point of view protection of this crop is urgently needed, as there is ample evidence that the disease is a major one.

As far as is at present known the disease has not spread beyond the Suva–Rewa and Lami areas, its incidence in other parts of the island is not marked and not epidemic in character. Disappointed growers are said to be moving out to Tailevu Province along the Transinsular Road and there is every possibility that they will take the disease with them in planting material. Practical plant quarantine measures are not possible but planters in the outer districts should make every effort to secure their planting material from clean areas.

It is still possible to control the spread of the disease by compelling the eradication of diseased areas prior to abandonment and by encouraging the rogueing of diseased plants from all plantations, and the selection of planting material from healthy stands only. It would also be advisable for a time at least, to discourage (if not prohibit) the planting up of large areas of yangona except under supervision as to source of planting material and subsequent care of plantations.

A brief article on the disease and its control was prepared and translated into Fijian and Hindustani for distribution among growers and inspections were inaugurated with a view to stimulating the eradication and destruction of diseased plants.

## CONCLUSION.

It is possible from information obtained to form the following conclusions:—

(1) The report describes the results of a survey of yangona plantations in the Suva–Rewa Road areas with special reference to the incidence of disease.

(2) The yangona plant and some of its varieties are described, methods of cultivation, costs of production and value of the crop discussed.
(3) The disease has been known for the past two years, being first noticed at Lami.
(4) The probability is that the disease is not an absolutely new one, but has come into prominence in recent years with the great increase in the areas planted to yangona. A similar trouble has been recorded as appearing at Kandavu.
(5) In the Suva–Rewa districts it is only recently that it has appeared in serious proportions.
(6) The trouble is definitely increasing in established plantations and rapidly makes itself felt in newly planted areas.
(7) Complete destruction of a plantation is not uncommon the average loss from disease without reference to age of crop is 30 per cent.
(8) Plants are affected at all stages, complete losses are experienced in young plantations, but areas up to 2½ years old have been more or less severely affected.
(9) There is no obvious correlation between soil and incidence of disease.
(10) Costs of growing the crop are given as £30 per acre on the average.
(11) Under present circumstances the growing of yangona is probably not commercially profitable in the diseased areas, owing to losses due to disease and poor market price.
(12) A total area of some 2,000 acres has been recorded in the Suva–Rewa–Princes Road areas, 1,288 acres of which has been specifically inspected in the course of the present survey.
(13) The nature of the disease is discussed, its probable cause and possible control measures.

## BRIEF NOTES ON SMALL COPRA DRIERS.

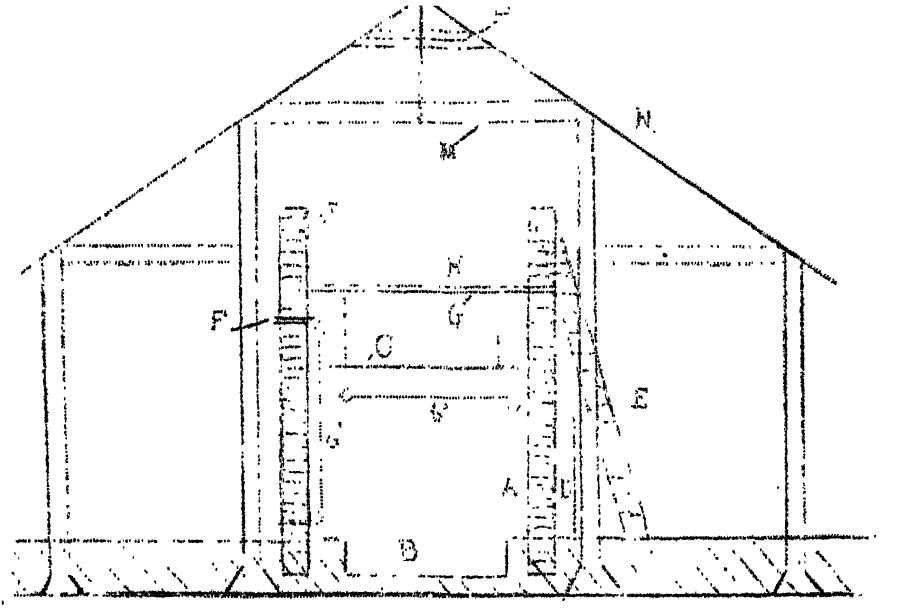
By

H. W. JACK, M.B.E., B.A., D.Sc.
Director of Agriculture.

TOURS of selected coconut areas in this Colony together with examinations of copra exhibited at the recent Fiji Show clearly indicate that local customary methods of copra curing fall far short of perfection.

Too much dependence is placed on sunshine as a drying force in a Colony where the rainfall, though not unusually heavy for the Tropics, is unusually prolonged in its distribution, greatly reducing the amount of sunshine available for copra drying and rendering the drying process not only too prolonged but too erratic for the production of good quality produce.

A number of Estates have, of course, long since realised the necessity of utilising artificial heat, but in many instances such heat is not used effectively, the drying frequently not being thorough and in some instances, being too rapid and resulting in case hardening and even scorching of the product. Moreover, many of the driers are expensive to construct in these days of competitive prices for copra, even if they produce good quality copra.




Section of 6' x 6' x 6' Copra kiln and covering shed and store. Capacity about 600 nuts per curing.

A. Walls of kiln, made of bricks, mud, planks or wattle bark etc.
B. Fire pit excavation 9" deep, for burning shells only.
C. Baffle plate (suspended) with numerous 2" holes to distribute heat uniformly
D. Door into fire chamber. Should fit well.
E. Steps up to copra drying platform.
F. Smoke escape.
G. Beam, iron or wood, to support drying platform.
H. Drying platform. May be laths, iron ribs, expanded metal, wire netting, bamboo, etc.
J. Copra draught shield of brick, wood, iron etc.
M. Structure for closed store which should be draught-proof.
N. Roof. (Grass, atap, corrugated iron or tiles).
P. Roof ventilation at ends of shed - not much required.

Note:- If the side walls of the kiln can be built so that the top is a little narrower than the bottom, hot air circulation will be improved.

While the method of curing described in this article is written primarily with a view to improving the quality of small holders' copra the same method can be equally well applied to large Estates, using larger kilns of the same design or batteries of four or six or more such kilns housed under one or more roofs, as they are on many of the Estates in Malaya and Ceylon where a better quality article, commanding a better price, than that produced in Fiji is normally prepared.

The driers described below depend on clean hot air derived from the burning of cleaned and well dried shells and to obtain a supply of these, husking the nuts before splitting is necessary and is the usual practice on all large and small holdings in Ceylon and Malaya. In those countries the husking is usually done at contract rates at a very low figure, a day's task being approximately 1,500 nuts including splitting and placing them on the drier. It may be mentioned that many hundreds of Indian labourers in the East often husk between 2,000 and 2,500 nuts daily, and Fijians locally easily do 600 in three hours. It may be mentioned that the average nut in Fiji is materially smaller than the average of Malaya.

For small holders, driers six feet by six feet by six feet high capable of dealing with the produce of 20 acres, are recommended while for larger areas or for several cultivators up to an aggregate of 100 acres, kilns twelve feet by twelve feet by six feet high are sufficient. An allowance of $1\frac{1}{2}$ square feet for each acre of cultivation and 20 nuts per square foot is the maximum that can be thoroughly cured at a time.

The walls of these kilns in Malaya are built of a variety of materials, mud, brick, mud reinforced by sticks or rough grass or wire netting, planks, coconut stumps or stones, with the chinks completely filled with puddled clay or cement or other materils to prevent escape of heat. Bricks are the handiest and most durable, but all the other materials give equally good results. *The essential is that the building material should retain heat and radiate it uniformly,* hence galvanised iron alone would not be satisfactory though it has been used in combination with an external wall of mud. A brick wall 12 or 15 inches thick has given the best results. Clay walls have the defect of cracking after a time and need constant repair, but also give excellent results. The best clay kiln is one composed of 80 per cent. heavy clay plus 10 per cent. sand plus 10 per cent. lime, after thorough puddling.

Other alternative materials in Fiji would include coral rock, mixtures of coral sand and clay, "canec" board, jungle stumps cemented with mud and coral sand or any other materials. It is an improvement if the top of the kiln is made slightly narrower than the base to promote circulation.

The shell fires should be sunk in an excavation nine inches deep to shield them from draughts and to give protection to the walls if they are made of inflammable materials. A few small smoke escapes, say one inch high by six inches long should be left in the walls just below the copra platform. The baffle plate to distribute the heat evenly—may easily be made by cutting a number of two inch holes in a flattened sheet of corrugated iron (say seven holes per square foot) and should be suspended about four feet above the fire. (See diagram).

The drying platform may be of four inches expanded iron covered by wire netting, but bamboo or wooden laths fastened firmly to stout cross beams will prove useful and cheaper than iron unless some local scrap yard should perchance provide the iron; stout beams placed two feet apart and covered with half-inch mesh wire netting have been found satisfactory, as have slender iron rods covered by wire netting. The drying copra should be shielded from draughts by a continuation of the brick wall or of a plank wall for 18 inches above the copra platform.

It is most important that the whole kiln be enclosed in a building to exclude draughts effectively so that the humid air over the copra is kept warm and so that heat efficiency is maintained while a very little ventilation at the top of the building is necessary to permit the escape of saturated air. The building or shed which should have doors, also serves the purpose of a store for copra, bags, shell for fuel and unripe nuts which must be matured.

It must be realised that for the preparation of high quality copra, *drying must be continuous and uninterrupted,* and slow drying is preferable to rapid drying—any interruption in the drying process will tend to affect quality detrimentally.

Also *only fully ripe brown nuts should be used* and they should not be split until just prior to the commencement of the drying, any nuts with germination *" apples " more than* $1\frac{1}{2}$ *inches in diameter should be discarded.* Only *dry shell free of fibre,* should be used so that it will burn freely with practically no smoke and it is advisable to store a fair quantity of dry shells ready for use.

If good sunny windy weather prevails, it is a good plan to sun-dry for the first day, placing the split nuts (after draining off the milk for an hour) so that the meat (still in the shell) will get the full sunshine. The same evening the copra must be placed on the kiln and a shell fire started using half shells cupped into each other and placed in a continuous line in the form of a " U " in the fire pit.

As the size of the shells varies considerably in different areas, the number of half shells, placed as indicated in the previous paragraph, which will burn for a given period of time say, six or eight hours or ten hours, must be ascertained by experiment in each district. This is important as the number of half shells used regulates the times of curing and the periods when attention must be given to the fires, although sufficient attention should always be available to see that the fires burn slowly and continuously.

The fires the first day (or night) should burn for 10 hours. The kiln being then kept closed to maintain the heat until morning when the half nuts require to be mixed or turned over.

Unless very favourable weather is experienced it is usually better to begin fire curing at once after draining the split nuts rather than resort to sun curing for the first day.

During the second and third day the heating is continued by making a single row fire as above described, during the day time, or if the weather is warm by merely maintaining the warmth in the kiln until three or four o'clock in the afternoon when a double row of shells is lighted and kept going for 10 hours or so. On the morning of the third day the shells are removed from the copra which is turned over in the process and on the morning of the fourth day a single shell fire, as on the first day, should again be lit as by this time a double fire might tend to char the copra surface.

Needless to say the store and the sacks should be kept clean and periodically inspected for insects. It may be mentioned that shell fuel consumption averages one whole shell for every two nuts converted into copra under Malayan conditions, which are not very unlike those in Fiji, but that fuel consumption will vary greatly according to precautions taken to keep out all draughts so that the heat may be maintained within the kiln.

With good precautions it should frequently be possible to avoid firing for spells of three or five hours provided that the temperature of the copra on the kiln does not drop below 50° Centigrade.

The diagram shown illustrates a six feet by six feet by six feet high kiln (800 nuts) on the lines described. A kiln of twelve feet by six feet by six feet high or twelve feet by twelve feet by six feet (1,500 and 3,000 nuts respectively per curing) may be constructed on exactly the same lines and further information or details which may be found necessary or desirable can be supplied by the Department of Agriculture.

Kilns of the type described have produced first class quality copra in Ceylon and Malaya for many years and can confidently be recommended, especially if built of brick (bricks may be available on the spot if suitable clays are found) which lasts for many years.

One local objection will be the necessity for husking nuts in order to provide shell fuel, but this has not been found difficult or expensive in the East and should not be difficult here once labourers become accustomed to husking.

The cost of construction of a kiln depends largely on the availability of suitable materials but six feet by six feet by six feet kiln should not cost more than £5 and one six feet by twelve feet by six feet high should not cost more than £25 under most local conditions. In addition to the kiln, there is the cost of its housing which is a necessity, as already indicated above, and its cost would again naturally vary considerably according to the availability of supplies of suitable materials.

Should the kiln be constructed of sawn timber or logs as many are in other countries, it is advisable to place a low protecting band of corrugated iron around the inside to minimise chances of firing the walls of the kiln.

It should be mentioned that slow drying at low temperatures is the rule in Ceylon and Malaya and most Estates prolong the drying process over a period of four days, some, however, stop after three days while others continue for five days.

It may be of interest to add that a small kiln of the type described has been erected at the Central Experimental Station at Nanduruloulou (where it may be seen by appointment) and that some first class copra produced on it was exhibited at the recent Agricultural Show held in Suva.

A few selected Native Field Assistants will be trained in this method of production of copra at the Central Agricultural Station, with the object of posting them in coconut producing districts where they will endeavour to instruct Fijians and others accordingly.

It matters little what the kiln is made of provided that it fulfils the required principles of regular uninterrupted uniform drying free from draughts, cold spots, unnecessary smoke and excessive heat. If these principles are assured, then cheapness of construction and upkeep should be the guiding factor.

If there are any matters which are not made clear in this memorandum, the writer will be only too glad to provide further explanations.

## SOIL INVESTIGATIONS.

### PART I—OBSERVATIONS ON METHODS.

By

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It has been recognised for some time that more complete information in regard to the soils of this Colony is required.

Between 1916 and 1919 soil investigations were carried out by C. H. Wright, a former Agricultural Chemist, and his work is recorded in *Bulletin* No. 9 " Soils of Fiji " and in *Bulletin* No. 11 "Alluvial Soils of Fiji." His work dealt with alluvial soils in relation to the main rivers of Viti Levu and with soils collected from other localities. No attempt however was made at a general classification.

An attempt was made in 1933 by the Government Chemist (*Annual Bulletin of Divisional Reports* 1933) to classify the soils of the Colony. This however, was only a preliminary attempt using Wright's information, a few field observations in 1932 and 1933 and chemical values determined in 1933. Further information obtained in 1934 together with the appearance of the Geology of Viti Levu by Dr. Ladd, indicates that this classification will have to be modified.

Agricultural development work demands an adequate knowledge of the soils of the Colony and any scheme of that nature must of necessity be prefaced by soil examination and soil mapping, particularly in the more settled portions of the Colony.

With the exception of a few isolated areas and Wright's work on the Alluvial Soils, no systematic study of the soil along modern lines has been made. It is therefore necessary to perform elementary work involving (1) a classification of the main soil types, (2) a determination of the physical and chemical properties of these main types, and (3) a determination of the manurial requirements of our crops on the main soil types. Bound up with work along the above lines are the problems of erosion and the reconditioning of the poorer soils.

In order to increase the efficiency and value of the work it was considered that the investigation of methods would prove a useful preliminary step for the following reasons:—

1. Owing to trained staff limitations it is essential, in order to tackle soil problems seriously, to choose rapid reliable methods which are simple enough to lead to good results in the hands of trained lay staff.
2. Tropical soils are, as a rule, peculiar and methods which are satisfactory under temperate conditions are not always reliable with tropical soil. This is well exemplified in the multiplicity of new methods which have been developed during the last five years, *e.g.* basic exchange and chemical availability methods.
3. Great developments have taken place in soil methods with the result that soils judged from the older standpoints should now be subjected to tests of the new requirements.

The following methods of examination from the standpoint of classification have been provisionally adopted for Fiji soils:—

ON ALL SAMPLES.

1. Hydrogen on concentration by colourimetric technique.
2. Lime requirements by the Hutchinson and Maclennan method.
3. Mechanical analyses by the Sudan sedimentation method, with slight modifications.

4. Humus content by the Sudan ammonia method.
5. Total phosphate by the Lorenz method, modified to deal with a hydrochloric acid extract.
6. Total potash by the modified cobaltinitrite method or the perchlorate technique.
7. Available phosphate by the Lorenz method in a citric acid extract.
8. Available potash by the cobaltinitrite method in citric acid extract.
9. Nitrogen by the Kjeldahl method or the recently introduced phenol. disulphonic acid method.

In certain localties profile examinations are made with a view to the determination of—

1. Exchangeable bases by the method of Rice-Williams.
2. Inorganic colloids by the Tamm's oxalate method.
3. The Silica to Alumina ratio in the clay fraction of the mechanical analysis.
4. Type of minerals and extent in the sand fraction.
5. Carbon by wet combustion methods.
6. Mineral characteristics of parent rock.

## EXAMINATION OF METHODS.

The methods used in conducting the more frequent processes required in a soil laboratory may be briefly discussed with advantage.

*Hydrochloric Extraction.*—The conventional manner of preparing a hydrocholoric acid extract is to take 25 grams of dried and pulverised soil and leave it in contact with 200 cc. of hydrochloric acid of specific gravity 1·115 for 24 hours on a boiling water bath. After cooling, the material is diluted, filtered and washed to bring the volume of the filtrate up to 500 ccs.

A considerable quantity of acid is used in this procedure, so that it is considered advisable in the interests of economy to cut down the quantity, accordingly only 10 grams of soil, and 80 ccs. of acid are now used and the filtrate is made up to 200 ccs. The concentrations are the same, and if care is taken in sampling there is no danger in using the smaller quantity of soil.

It is not convenient under local conditions to keep soil and acid on the water bath for a period of 24 hours. The procedure is accordingly modified to keeping the soil and acid in contact for a period of three days, five hours each day being at the temperature of the boiling water bath. Extracts made in this manner are not greatly different chemically from those developed in the normal manner and have the advantage of a saving of acid.

*Citric Acid Extracts.*—It has been the practice to determine available phosphate and potash by 1 per cent. citric acid extraction of the soil by the original Dyer technique. In attempting to save time use is made of a rotating shaker devised from a bicycle wheel with beer bottles attached as containers. It is found however, that quantities have to be reduced since each bottle is only capable of holding 500 ccs. and the use of several bottles in extracting the one soil introduces repetition of several operations. The original technique is now modified by the use of 1½ per cent. citric acid concentration and this modification appears to give results similar to those obtained by mechanical shaking using 1 per cent. citric acid. Ten samples can be carried out at the same time under existing working conditions and the acid solution is left in contact with the soil for seven days, each container

being shaken thoroughly once every hour during the working day. The quantities used are 250 grams of soil, 25 grams of citric acid and 2000ccs. of water. The amounts of available plant foods are small and therefore it is considered that no attempt should be made to cut down the quantities in order to take advantage of a shaker. As in all soil work the main consideration is the absolute reproduction of technique so that all values may be comparable.

*Hydrogen ion concentration.*—Owing to the absence of electrometric equipment, the hydrogen ion concentration is determined by the colourimetric process using Gillespie's drop ratio method. Extracts of one to five on clay soils' and one to three on sandy soils are used and the extract is cleared by centrifuging. In difficult cases the collodion sack method of securing a clear filtrate is adopted. The soils of the Colony are mainly of an acid nature free calcium carbonate being almost always absent. Acidity of the main soils, shows the following fluctuations:—

| | |
|---|---|
| Alluvials .. .. | .. 5·4 to 5·9 Ph. |
| Lateritic soils .. | .. 4·9 to 5·4 Ph. |
| Soapstone soils .. | .. 6·0 to neutral. |
| Red brown soils .. | .. 5·5 to 6·0 Ph. |

*Lime Requirement.*—The Hutchinson and Maclennan method of assessing the lime requirement has been adopted owing to the fact that with Fiji soils the indication shown is fairly well correlated with the actual lime requirement. The actual requirement on the wet side of Viti Levu is between 2 and 3 tons per acre, on the lighter soil, and up to 5 tons or more on the more acid soils of Suva.

*Mechanical analysis.*—Mechanical analyses carried out by the Robinson Pipette method, although simple and rapid in the hands of the Chemist, lead to erratic results with the type of native staff available in a tropical Chemical laboratory. In this method it is essential to get complete dispersion; without this the subsequent technique, however careful, is useless. It is, therefore, advantageous to use sedimentation methods and the beaker method, as practised in the Sudan is now adopted.

It is found however that complete dispersion cannot always be obtained by the normal sodium carbonate procedure by shaking or puddling, but that a preliminary boiling with 0·2 per cent. sodium carbonate yielded good comparable results.

The following technique has therefore been adopted: Five grams of the fine over-dried earth are thoroughly puddled with 5 ccs. of 0·2 per cent. sodium carbonate solution. The volume is increased to 75 ccs. and the suspension brought to the boil and maintained at boiling point for three minutes. The suspension is then transferred to the sedimentation beaker with 0·2 per cent solution of sodium carbonate and brought up to 250 ccs. to the depth of 10 cms. in the containing vessel. After 16 hours the suspension is poured off and remade with 0·05 per cent. sodium carbonate solution. This and subsequent sedimentations are alternately of eight hours and over night duration. After the fourth subsidence, puddling with a camel hair brush using 5ccs. of 0·2 per cent. sodium carbonate solution is carried out. Most of the clay is washed out in from four to eight days; after the clay has been removed and its amount determined by difference in the usual way, the silt is separated by a deposition of the remaining soil for a period of four minutes, 19 seconds, the normal temperature being in the neighbourhood of 25° C. The settling time of seven and a half minutes adopted by the Sudan method is too long for tropical temperatures and leads to low silt values. After drying the residue from the clay determination the soil

becomes slightly caked, necessitating a little working with a camel hair brush, before sedimenting for the silt value. The fine sand is separated from the coarse sand by sieveing in the usual manner.

No preliminary acid treatment is required with Fiji soils owing to the absence of calcium carbonate, also the percentage of organic matter is low with the result that the soil is not subjected to the hydrogen peroxide treatment. In any case it is impossible to keep hydrogen peroxide for long under tropical conditions. As with the Sudan method, the values are determined on the oven-dried basis. This technique has yielded good results in the hands of a native assistant who can carry out from 15 to 20 samples a week and still have time left for general routine. It is proposed when time permits to carry out a comparison with the Robinson technique.

Careful microscopic examination of the fine sand and coarse sand fractions indicated that clay and silt are effectively removed. The following results obtained by a native assistant show the accuracy to be expected:—

| Sample No. | Clay. | Silt. | Fine Sand. | Coarse Sand. |
|---|---|---|---|---|
| Koro No. 1 . .. .. | 24·6 | 4·8 | 68·6 | 1·8 |
| Koro No. 1 (repeat) .. | 23·5 | 5·3 | 68·4 | 2·6 |
| Navuso No. 1 .. .. | 16·1 | 12·2 | 57·3 | 14·3 |
| Navuso No. 1 (repeat new sample) .. .. .. | 15·0 | 15·9 | 53·1 | 16·0 |
| Navuso No. 2 .. .. | 23·4 | 9·6 | 58·3 | 8·6 |
| Navuso No. 2 (repeat new sample) .. .. .. | 23·3 | 11·6 | 57·8 | 7·3 |

*Humus.*—At the moment from the point of view of simplicity the humus content is determined by the ammonia method which appears to give low but comparable results. Values of one to two per cent. are usually obtained for the Rewa alluvials by this procedure.

*Total Phosphate.*—The official method for the determination of phosphates gravimetrically takes much time and the volumetric method is not altogether reliable and it is considered that the Lorenz method 1901 modified by Neubaur in 1912 and used extensively in Germany and Austria should give quicker results.

In the case of the official method the precipitation of the phosphate as ammonium phosphomolybdate and then as magnesium ammonium phosphate introduces liability to error. Also in soils where phosphate is low the precipitate may be effected to a considerable extent by traces of impurity.

The bulky Lorenz precipitate has a distinct advantage over the pyrophosphate weighed in the official method. The factor for the Lorenz precipitate to phosphate is ·03295 and the magnesium pyrophosphate to phosphate is ·5379. That is, for a given weight of phosphate, the Lorenz precipitate is approximately 18 times that of the pyrophosphate. A difference of one milligramme in the former is equivalent to ·05 milligrammes in the latter. This is of distinct advantage on poor soils containing low available phosphates, the quantity of which obtained by the official technique would almost be negligible. The advantage of the Lorenz method from this point of view is apparent.

It is usual in the Lorenz technique to determine the phosphate from a nitric acid extract of the soil. This is not convenient owing to the fact that the recognised official extract is with hydrochloric acid and it is impossible to determine phosphate by the Lorenz method directly on the hydrochloric extract, owing to the high concentration of chlorine ions.

Nitric Acid extracts of the soil have been made and the phosphate determined by the A.O.A.C. and Lorenz methods. Hydrochloric extracts of the same soil contain more phosphate, as indicated in the following table:—

| Soil. | Extract. | Phosphate by Lorenz methods. | Phosphate by official meth. |
|---|---|---|---|
| Vatulele 1 | Nitric acid extract as for Lorenz meth. | 0·66 | 0·70 |
| „ | Repeat .. .. .. .. .. | 0·66 | 0·70 |
| „ | Hydrochloric acid official method .. | ... | 0·83 |
| „ | Repeat .. .. .. .. .. | ... | 0·85 |

The Table indicates that the Lorenz method gives reproducable results of the same order as the official method but that the official hydrochloric extract contains more phosphate than the Lorenz nitric acid extract.

Hence it is deemed advantageous to make hydrochloric acid extracts of the soil according to the official method and to determine the phosphate by the following technique.

(1) Total phosphate. Fifty ccs. of the hydrochloric extract are evaporated on a hot plate to a volume of about 5 ccs., 5 ccs. nitric acid are then added and evaporation is continued to near dryness. A further 5 ccs. of netric acid are added and evaporation is continued to complete dryness. The residue is dissolved in 20 ccs. of nitro-sulphuric acid regeant and warmed to effect complete solution, when 20 ccs. of water are added, the material filtered and the basin, residue and paper washed with 10 ccs. of water. The concentration now corresponds with the dilute nitro sulphuric acid medium of Lorenz and the phosphate is precipitated directly from this medium in the normal manner by the special Lorenz precipitating agent. Excellent results are obtained.

*Available phosphate.*—Two hundred ccs. of citric acid extract where available phosphate is 0·01 per cent. are evaporated to a small volume in an aluminium basin on the hotplate. The residue is transferred to a silica basin and evaporation continued to dryness with the addition of 0·5 ccs. of nitric acid just before final evaporation. The residue is strongly ignited (preferable in a muffle furnace) dissolved in nitro sulphuric acid and the phosphate determined as described under total phosphate.

Several attempts were made to determine the phosphate in the citric and hydrochloric extracts of the soil by the Molybdenum blue colourimetric technique which is more rapid than the Lorenz method. Unfortunately it has been found that Fiji soil extracts fade so rapidly that accurate comparisons were not possible and hence the method has been abandoned.

*Potash.*—It has been the practice in Fiji to determine the potash on the hydrochloric and citric acid extracts by the perchlorate technique. The method in the hands of a trained chemist gives accurate results, but has the disadvantage of being rather long.

It was therefore considered worth while to experiment with the sodium cobaltinitrate method of G. Milne (J. Agr. Sc. 1929, 19,541), modified to prevent retention of potash by Ferric oxide. The method is entirely satisfactory and with colourimetric technique is extremely rapid. The green solution is very suitable for colourimetric comparisons and provided traces of silica are removed by filtration, there is no difficulty in making an accurate colour comparison. It is very essential to keep the cobaltinitrite solution in a dark bottle and it is advisable to make up requirements for a month only.

## SOIL INVESTIGATIONS.—THE SANDY LOAMS OF THE CENTRAL AGRICULTURAL STATION.

By
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IN the Annual Report of the Government Chemist for the year 1933 it was mentioned that the soils from the Central Experimental Station, adjacent to the river bank, were of sandy loam type—but that they showed no evidence of bedding in the manner normal to alluvial soils and displayed an even texture to a depth of at least nine feet.

A profile examination which has been made in the drain bordering banana block No. 3 at the river end and to a depth of nine feet, revealed additional information shown in the table below:—

| Zone. | Colour profile. | Depth profile. | Acidity as P$_H$. | Total phosphate. | Available phosphate. | Total potash. | Available potash. | Fine sand. | Coarse sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | % | % | % | % | | | | |
| A. Top Soil .. | Brown-black .. | 2′ 6″ | 5·9 | 0 126 | ·013 | ·31 | ·012 | 53·4 | 3·1 | 21·6 | 21·9 |
| A1 Sub soil .. | Brown . .. | 1′ 6″ | 5·9 | 0·132 | ·012 | ·40 | ·016 | 56·8 | 7·1 | 17·3 | 18·8 |
| A2 Sub soil .. | Light-brown .. | 1′ 6″ | 5·9 | 0·101 | .. | ·37 | ·018 | 62·0 | 3·5 | 19·0 | 15·5 |
| B. Sub soil .. | Brown . .. | 3′ 6″ | 5·9 | 0·118 | ·008 | .. | ·064 | 51·0 | 5·5 | 25·2 | 18·3 |

Nitrogen content Zone A=0·177 per cent. Zone B=0·112 per cent.

Similar water relationships were indicated throughout the profile and the impression was formed of a fairly compacted type of soil more of the nature of a heavy loam rather than a sandy loam as indicated by the mechanical analysis.

The soils of the station are peculiar in possessing a high fine sand content with similar clay and silt values. They are, at times, difficult to work this difficulty when dry being ascribed to their peculiar mechanical composition.

From the chemical standpoint these soils appear to contain an abundance of plant food in a readily available condition and despite the heavy rainfall of some 140 inches per annum there is little evidence of extensive leaching or washing down of the finer particles. Available phosphate decreases with increase of depth of the profile whereas the available potash increases with a well marked zone of accumulation at B (below 5 feet 6 inches).

The horizons of Zone A are determined more particularly by colour changes and there is no visible evidences of lateritisation.

The soils on account of their high potash content and physical features, would appear to have been derived more particularly from the sandstones, tuffs and marls of the Suva series and to have been laid down at the mouth of the river or in shallow water near the mouth. Subsequently it is estimated that they were elevated and cut through by the water system of the present Rewa river.

The soils of the station can be improved mechanically by green manuring, liming and constant working when weather conditions are favourable. Their chemical composition is entirely satisfactory although they would probably respond to phosphatic fertilizers.

The chemical findings in regard to these soils are well correlated with actual field trials. Excellent crops of bananas (where they escaped disease), and cane having been grown on these soils in the past.

## SUMMARY RECORD OF ENTOMOLOGICAL WORK IN FIJI.

By
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ECONOMIC entomology in Fiji can be said to have commenced with the appointment in 1905 of C. H. Knowles as Superintendent of Agriculture. This officer, although not himself an Entomologist, recognised the losses due to insect agency and the difficulties attendant upon their control by cultural methods when dealing with native populations, and early turned his thoughts to biological methods in dealing with these problems. There is no doubt that much of the phenomenal success which was later attained in this direction was greatly facilitated by Knowles' early work and researches.

In 1909 Mr. F. P. Jepson was appointed Government Entomologist, and this officer carried the work on considerably further, working out the life history of many insects and being particularly interested in those species connected with the transmission of disease.

A year after his appointment Jepson was sent to Hawaii for a month to study the work which was being carried on in that Group. Arising out of this mission, and through the good offices of the Hawaiian Sugar Planters' Association and the United States Department of Agriculture, the Mexican seed destroying fly *Agromyza lantanæ* was successfully introduced into Fiji against the weed, *Lantana camara*. Jepson also introduced Top Minnows from that country into Fiji where they are now locally abundant and prove useful as predators of mosquito larvæ.

In 1911 Jepson visited Samoa to investigate the results arising from the disastrous introduction of the Rhinoceros Beetle *Oryctes rhinoceros*, into that Group and to evaluate the menace thus threatening Fiji.

In 1913 he made another overseas trip, this time to Java, in search of natural enemies of the banana borer, *Cosmopolites sordidus*. He introduced the predatory beetle, *Placsius javanus* thence into Fiji and although many years elapsed before any definite results were evident, from this introduction it is now widely distributed over Viti Levu and is known to be doing good work. With the outbreak of the European war overseas missions were necessarily curtailed, and it was not until 1919, when H. W. Simmonds came to Fiji, that this method of attacking problems was resumed.

At this time four major problems were facing agriculture in Fiji:—

1. The scale *Aspidiotus destructor*, then called the banana scale, had spread to the coconut districts with disastrous results.
2. The coconut leaf moth, *Levuana iridescens*, annually destroyed practically the whole of the coconut crop on Viti Levu.
3. The melostomaceus plant, *Clidemia hirta*, had become a weed of such magnitude as to be called "the curse."
4. In the Lau and drier parts of Vanua Levu a leaf mining beetle, *Promecotheca reichei* swept like a fire through the coconuts at intervals of some years.

So serious were these problems that it was proposed to offer a reward of £5,000 to anyone who would bring either No. 2 or No. 3 under control and one officer was actually engaged at a salary, expenses and the offer of the reward if successful in controlling No. 2.

With regard to the first of these problems, in 1919 Simmonds was invited to undertake a special mission to Tahiti to introduce a Chalcid reported by Doane as having done excellent work in controlling the scale *Aspidiotus destructor* in that Group. On arrival, investigation revealed that two para-

sites were attacking this scale in Tahiti, viz. *Aspidiotiphagus citrinus*, Craw, and *Aphelinus chrysomphali*, Mercet. The latter was successfully transported and soon spread throughout Viti Levu, doing valuable work. There is, however, reason to believe that it was actually already present in Fiji, on Taveuni, at the time of the introduction, where it was living on another species of scale, *Chrysomphalus dictyospermi*; *Aspidiotus destructor* not at that time having reached that island, and thus the presence of this natural enemy in Fiji was unsuspected. The other species landed in very small numbers, and it was found advisable to reinforce the colony, and a second trip was undertaken again by Simmonds in the following year. Both these insects did good work, but although greatly reduced in intensity, the pest continued to spread to new areas, and further work became necessary some years later.

The coconut leaf moth (*Levuana iridescens*) had been known for perhaps 40 years, during which time it had been confined to Viti Levu. In 1922 Simmonds observed that the coconuts on the Island of Caqalai were badly diseased and investigation showed that it was due to this insect, which had also reached Moturiki. In doing this it had bridged the gap separating Viti Levu from the Lomaiviti Group and thus threatened the whole coconut industry of Fiji. Whilst the pest was only known from the one island of the Viti Levu Group there were a number of reasons for assuming that it was an introduction and that could its original home be discovered it would be found to be closely controlled by parasites.

In the hopes of discovering this original habitat Knowles had instituted enquiries, and ascertained the presence of another related insect with similar habits in Malaya where it was reported to have many enemies, both insect and fungus. Opinions, however, differed as to the probability of parasites of the Malayan insect attacking the Fijian species, the more so that they belonged to different branches of the *Zygænidæ*. Simmonds was therefore instructed to search for the original home of *Levuana* and, to that end, spent eight months in 1923, working through New Guinea, the Bismarcks, Solomon and New Hebrides Groups. Although many new coconut insects were discovered and much of interest ascertained, no trace of the feeding marks of this or any allied larvæ were observed.

In 1924, Mr. Despeisses, then Superintendent of Agriculture, engaged A. M. Lea, Government Entomologist of South Australia, to search for the pest in the New Guinea region, failing which he was to proceed to Malaya and endeavour to introduce the parasites of the above mentioned allied moth, *Artona catoxantha*. After spending some time in the Torres Straits district, Lea proceeded to Malaya and Java, from which latter, he made two attempts to introduce parasites of *Artona catoxantha*, both proving unsuccessful.

Meanwhile, in view of the serious spread of the pest, Dr. Tothill, a Canadian Entomologist, had been appointed to take charge of the work, and he was accompanied by Messrs. R. W. Paine and T. H. C. Taylor, two Entomologists from England. These latter remained for a month in Hawaii, en route to Fiji, in order to study the methods adopted in that country.

With the failure of Lea's attempt to introduce the parasites of *Artona* from Java, Simmonds was despatched to Kuala Lumpur (Malaya) to await another outbreak, with the aim of renewing the attempt, using, however, different methods. On arrival in Malaya no big outbreak was in progress, but sufficient material was discovered at Batu Gajah to work out the life cycle of certain parasites. Simmonds was joined by Taylor who was instructed to assist with the investigations of what then appeared to be *Artona*

under normal control. Shortly after Taylor's arrival a major outbreak was reported and from this outbreak parasites were collected in immense numbers, transferred to 85 coconut seedlings growing in kerosene tins placed within 17 specially made very fine wire gauze cages and railed to Singapore for shipment to Fiji in charge of Taylor. Although some 20,000 larvæ of the *Artona* had been shipped, only 315 parasites *Phychomyia remota* reached Fiji alive in August, 1925.

From these 315 parasites, colonies were bred in large numbers and distributed to make one of the most spectacular successes of entomological history, the *Levuana* pest being still completely under control as a result of this valuable work.

With the control thus obtained against *Levuana* the scale *Aspidiotus destructor* assumed the position of the most serious enemy with which the coconut grower had to contend. In certain parts, particularly Moturiki, the east coast of Ovalau, and the Wainibokasi region of Viti Levu, this pest had, prior to the introduction of the Tahitian parasites, caused the complete loss of the crop. Although these imported parasites had greatly improved the position in certain parts, particularly in Ovalau, the pest continued to extend its range, reaching Vanua Levu and eventually Taveuni. In the latter island, however, a highly efficient control had already been established in Fiji before the arrival of the pest. With the object of checking the virulence of the insect Taylor introduced several other internal parasites from Java. No benefit can be said to have followed this introduction and he was despatched to Trinidad where Urich had reported two ladybirds as doing good work against the pest in that country. Taylor discovered several additional predators and successfully imported five ladybirds into Fiji. Curiously only one of these, *Cryptognatha nodiceps*, proved of any great value in its new home, but this was so successful that the scale is to-day closely controlled throughout Fiji, so closely that its other enemies have almost disappeared.

Whilst this work was in hand, Paine was engaged in endeavouring to establish a number of natural enemies of another coconut pest *Tirathaba trichogramma*, which Taylor had shown to be a causal agency of serious premature nutfall. This work entailed two visits to Java and occupied a number of years, but he was eventually successful in establishing throughout the Group a series of parasites attacking the pest at consecutive stages, with present indications of definitely increased yields.

Meanwhile Simmonds carried out important investigations with a cotton pest and succeeded in showing that a brown stain of the lint which was causing trouble was due to the mechanical action of attack by the bug *Tectocoris lineola*. It may be possible to reduce the numbers of this pest should cotton become an important industry in Fiji, but for the present this work is not being continued.

The same worker demonstrated the probability that flight was a major factor in the spread of the banana borer and also evolved a method of obtaining clean planting material from infected stock by soaking in fresh water for 21 days.

In 1927 Simmonds was sent to Honolulu to obtain a colony of the lantana bug *Teleonemia lantanæ*, which had been introduced into that island by Koebele. Through the kind assistance of the officers of the Hawaiian Sugar Planters' Association this mission was successfully accomplished and the bug is now well established in Fiji. It has, however, in this Group become subject to predatory enemies and its value against the weed is hampered by the long wet spells which are of frequent occurrence, though during dry seasons good results are apparent.

Meanwhile the melostomaceus weed *Clidemia hirta* had become so prevalent that it became commonly known as "the curse." Knowles had already located the original habitat of the pest as Central America and the West Indies, and in 1921 Simmonds sent drawings and material to the Department of Agriculture, Trinidad, in the hopes of obtaining some agency to hold it in check. Arising out of these requests attention was given to the plant, and Urich discovered the thrips which now bears his name, *Liothrips urichi*. When Taylor was in Trinidad collecting ladybirds to control the scale he was instructed to investigate the position and as a result of preliminary investigation, reported favourably upon the insect. As a consequence, a student, Cook, was instructed to investigate the matter further. This officer whilst not discovering any objectionable habits in the insect placed a low value upon it as a control. Despite this, in view of the rapid spread of the weed it was decided to introduce the thrips, the work being entrusted to Simmonds who proceeded to Trinidad.

Shortly after arrival in Trinidad it became obvious that other and more powerful agencies than the thrips were preventing the spread of the weed in that country, and the presence of a number of previously unsuspected seed-destroying agencies was discovered. Despite this it was considered that the thrips was, in the first instance, the most desirable for introduction to Fiji, since it actually destroyed the plant, not merely the seeds. The insect was successfully introduced and achieved a remarkable success over large areas, where useful herbage has now replaced the weed. As, however, the thrips does not thrive under close shade and in certain other special conditions the introduction of one or more of the seed destroying agencies might still prove of economic value.

The coconut leaf mining beetle pest *Promecotheca reichei* which was normally confined to the drier portions of the Group was next given attention, for although subject to several parasites, its ravages frequently led to the entire loss of the crop over considerable areas.

In Java and Malaya the allied *P. cummingi* was known to be well controlled and Taylor was therefore despatched to Java to attempt the introduction of one or more of the natural enemies existing in that country. In this work he was entirely successful and by the introduction of the Chalcid *Pleurotropes parvulus* the coconut industry in Fiji had demonstrated three spectacular entomological successes.

In this connection a tribute must be paid to the technique evolved by Taylor who made an artificial leaf mine with microscope slides in order to handle these Chalcids, also to an equally ingenious method of removing the ovaries of the parent fly and distributing the eggs, which was devised by Paine, for the mass breeding of the Tachinid *Erycia basifulva*, a parasite of *Tirathaba*.

Whilst the above résumé covers the major operations of the Entomological Division of the Department of Agriculture in Fiji it by no means includes everything. No mention has been made of the successful introduction by Paine of the *Megarhinus* mosquito, nor of that officer's general mosquito work, nor has reference been made to importations of housefly enemies and certain other insects by Simmonds. Enough has, however, been stated to indicate that valuable work has been performed within the Colony although it is not possible to evaluate the work in terms of cash.

There have been disappointments and striking successes and there are still many problems ahead, such as the fruit fly upon which Simmonds is now working and the blue rat tail weed pest of which, when in Trinidad he found the seeds being destroyed by a *Cecidomyiid*. Still, it is a far cry

from the days when the coconuts of Viti Levu were brown with *Levuana* and Moturiki and Ovalau were yellow with scale. The retreat of the " curse " and the removal of the periodic losses due to the leaf miner have all represented solid cash to the country and make one look forward to other successes in the constant struggle between the agriculturist and those agencies which so often deprive him of the fruits of his labour.

## FRUIT FLY IN FIJI.

By
H. W. SIMMONDS, F.R.E.S.
Government Entomologist.

MOST fruits in Fiji suffer severely from the attacks of certain insects, chief of which are the fruit flies of the genus *Chætodacus* (Bezzi) and the fruit piercing moth *Othreis fullonica* and its allies. The larvæ of this latter feed on the *Drala*, (*Erythina* sp.) and these trees should be destroyed in the neighbourhood of orchards. Of the fruit flies two species are common:—

(1) *Chætodacus passiflorœ*, Frogg. which is endemic and probably peculiar to Fiji. This species attacks guava, citrus, kavika, granadillas, ivi, pawpaw, cotton bolls, sandalwood seed and other fruits.

(2) *Chætodacus xanthodes*, Broun, which occurring also in Samoa and Raratonga may be an introduction and is certainly not so generally distributed throughout Fiji as *C. passiflorœ*. It is recorded as attacking granadillas, citrus, guavas, pawpaw and pineapples.

Yet another species, allied to *C. distinctus* of Samoa, has been captured by the writer in Suva, but its habits and distribution are still unknown.

During the past year work in the entomological division has been concentrated upon the two major pest species, *C. passiflorœ* and *C. xanthodes*, and some interesting results obtained.

It was found that with the advent of the guava season the numbers of fruit fly maggots in the fruits rapidly increased, despite the attacks of two parasites. This increase was followed by a heavy concentration of the predatory bug, *Germalus pacificus* which sucked the newly laid eggs of the fly, leading to an equally rapid decline in the numbers of the pest until, towards the end of the guava season, all fruit found was quite free from attack.

This freedom from attack lasted six to eight weeks, viz., July–August, when odd guavas were found again to be punctured. Despite this cleaning up in the big guava areas, ripening citrus and kavikas continued to suffer, showing an unexpected localisation of the pest and also that *Germalus*, which normally is abundant and breeds upon *lantana*, does not concentrate on either of these fruits to any extent.

It was found that fruit flies show a definite preference for certain fruits, chief of which are guava (all kinds), kavikas and mandarins.

In view of the fact that both the native parasites, *Braconids* of the genera *Opius* and *Biosteres*, attack the maggots of the fly by piercing them through the skin of the host fruit, they are only able to reach such as are near the surface and those lying deeper within the tissues escape, it was felt that, if a parasite could be obtained which entered damaged fruit in search of its prey, valuable results might be attained.

Such a parasite suggested itself in the Eulophid, *Tetrastichus giffardianus*, which had been introduced from West Africa into Hawaii against the Mediterranean fly, *Ceratitis capitata*, Wied. and, through the courtesy of the United States Department of Agriculture and the Matson Line, a small colony of this insect was successfully imported. These took kindly to both species of Fijian fruit flies and bred up rapidly in the laboratory, the original ten increasing to about 12,000 in four months. Colonies of the new introduction are being distributed about the Group as rapidly as possible and have been recovered on the Rewa–Suva road, where a parasitism of 20 per cent. by this species has already been obtained. It remains to be seen to what extent it will be able to bridge the period of host fruit scarcity July–October, but the present indications are distinctly hopeful and, it seems probable, that, if an appreciable reduction can be attained in the fly population early in the guava season, there will not be the numbers about when the citrus commences to mature and that this fruit, which is seasonal in character and, not the most favoured host of the pest, may to some extent at least be protected from attack.

## THE MAHOGANY TREE.

By
H. W. JACK, M.B.E., B.A., D.Sc.
Director of Agriculture.

AT the end of last year Mr. H. W. Simmonds, Government Entomologist drew the writer's attention to the two mahogany trees (*Swietenia macrophylla*, King) growing at Nasinu and arrangements were made to have one large fork lopped and sawn into planking, of which a sample was polished and despatched to the Imperial Institute London for favour of examination and report.

The trees referred to are now some 23 years old are growing in poor soil and one has a girth measurement of some eight feet at the base while the other shows almost equal growth but was forked at the base (until cut).

It was one of the forks of the latter tree which was lopped, seasoned, and sawn into planks to give the sample which was polished and forwarded to London for examination as to its commercial value as a timber. The timber polished to a light brown colour and local contractors maintained that it " worked " excellently.

In a detailed report which has been received from the Director of the Imperial Institute, he states that the sample planks were examined with much interest by the Institute's Advisory Committee on timbers and surprise was expressed at the rapid rate of growth of the tree from which the timber was cut.

The Committee regarded the grain of the timber as somewhat irregular but on the whole the timber was considered promising and the Acting Chairman of the Committee (Mr. J. P. Fraser) who had much experience of the mahogany trade undertook to examine the specimens and report thereon.

Mr. Fraser duly reported on the sample boards and recommended the planting of the tree generally in Fiji. In his report he stated that the sample pieces were " exceptionally wild in growth and rather defective

but seeing they have been cut from a tree only 18 years old, I am not at all surprised. Candidly I think it is wonderful that a tree only 22 years old can produce boards of this size" and "in spite of the wild grain the sample pieces have planed up well so that there is really nothing fundamentally defective in the flowery grain."

He also pointed out that at present mahogany was rather out of fashion but emphasised his opinion that mahogany would again come into vogue and hold the market for about 20 years when there would be "bound to be a demand for wood of curly or wild grain as well as for straight grained timber" and that he was "unhesitatingly of opinion that there would be a good market in the United Kingdom."

His report finished with the assertion that Fiji "should certainly plant up large areas with the wood looking forward with considerable confidence to the future, always provided, of course, that the land is cheap and the cost of planting is reasonable."

The Director of the Imperial Institute in his covering report states that timber of the same species of mahogany grown in Ceylon was examined previously by the Institute and that the results of working trials were entirely satisfactory and, moreover, that the Timbers Committee were of opinion that there would be no difficulty in marketing timber of equal value. Similarly in 1931, Madras grown timber of this species examined at the Forest Products Research Laboratory in England indicated that the actual quality of the timber compared reasonably well with native grown Honduras mahogany.

In notes received from the Imperial Institute, it is pointed out that considerable success has been obtained with the cultivation of this species of mahogany in India, Ceylon, British Guiana and Trinidad and that the trees had shown remarkable rates of growth. Annual girth increases in Ceylon and India of 1·7 to 2·5 inches had been recorded as well as girth measurements of over eight feet for trees up to 39 years old.

In British Honduras two systems of planting mahogany have been employed. In the first system the mahogany is raised by the natives in the maize fields, seed being sown in nurseries and the seedlings when five to six months old being planted out at distances of 10 by 10 feet in the standing maize which affords cover during the first year of growth. Thereafter the mahogany is sufficiently established to compete with secondary growth which invades the clearing and quickly closes the canopy. "Thinnings are not saleable so that closer spacing is unnecessary and in any case, the preservation of a mixed canopy for soil protection all the year round is considered desirable" (Kinloch *The Methods of Regeneration of Mahogany in British Honduras*).

The second system concerns the restocking of cleared areas. In a paper on the *Cultivation of Mahogany in British Honduras* by Oliphant (British Empire Forestry Conference 1928) he states that the most favourable environmental conditions for the establishment and development of young mahogany are those prevailing in second growth in cleared areas. In such areas seed is dibbled or seedlings are planted concurrently with or after harvesting a crop of maize. He further maintains that in a regeneration of existing forests an ultimate stock of 40 trees to the acre is sufficient and the advantages of groupwise distribution may make it worth while to reduce the concentration still further.

Numerous published accounts indicate that mahogany thrives well on a variety of soils (alluvial, lateritic, &c.) as long as they are moderately well provided with humus and normal plant foods. The trees demand a fair amount of light but will stand moderate shade; they do not coppice

well and are sensitive to mechanical damage and fire. Young plants stand transplanting well and the general rate of growth is rapid. The chief pest recorded as being destructive to the sp cies is the shoot borer (*Hypsipyla grandella*, Zell.) which enters the terminal bud of the leading shoot and causes the stem to fork, thus preventing the formation of long clean boles, but this pest has not yet been found in Fiji according to the records of the Government Entomologist (Mr. H. W. Simmonds). In Trinidad, attacks by this pest appear to be avoided by raising the seedlings in moderate shade in the forests and then gradually reducing the shade over a period of four years.

In the same Island, Urich reports that the West Indian Mahogany is highly resistant to attacks by *Hypsipyla* as compared with the Honduras species (Bull. Imp. Institute, June, 1935,) and hence mahogany seed has recently been imported from Trinidad rather than from British Honduras.

It is understood that several leading personalities in Fiji have seen the few mahogany trees, now 23 years old, growing at Nasinu and in these notes an endeavour has been made to indicate the potential value of this tree in the regeneration of local forests where they have been stripped of all their timber of commercial utility.

Furthermore, the planting of this and other suitable timber trees, which require some shelter in their young stages, should prove useful in the reclamation of waste lands now occupied by guava, lantana and other useless shrubs which form such a large aggregate area in Fiji.

It is hoped that this brief note will stimulate some interest in the value of this tree and that it may be made possible in the near future, to give practical effect to the suggestions which are put forward.

## VETERINARY AND ANIMAL HUSBANDRY NOTES

### MAIZE FOR WORKING ANIMALS.

By
C. R. TURBET, B.V.Sc., M.R.C.V.S.
Senior Veterinary Officer.

DURING recent visits to cane growing districts it was seen that working stock of the great majority of small cane farmers were not being kept in good working condition. The cause of this was that supplementary feeding was not being practised. The horse, or any animal for that matter, cannot be expected to work really well unless he is fed well. Probably the best concentrate feed available to cane growers is maize.

Apart from the question of animal husbandry farm economy enters prominently into this discussion, since one of the difficulties of the small agriculturist in Fiji is to find satisfactory money crops as opposed to those crops which are grown for food. Formerly maize was largely grown and provided a very satisfactory crop for small farmers. A fairly constant market was available in the sale of maize for the feeding of large numbers of horses used on plantations controlled by the Colonial Sugar Refining Company Limited and other Companies. Maize constituted the chief concentrate ration for their working horses and bullocks and every year large quantities of maize were purchased for this purpose.

There was a period a few years ago when it appeared that horses would be substituted in agriculture by tractors and, of course, that would mean the absolute loss of that avenue for the disposal of maize. More recently, however, it has been found that horses are more than holding their own against the tractor for agricultural purposes in Fiji, but on the other hand, the large European controlled estates have almost ceased to exist. Horses are not now stabled in large stables under expert management, instead the large estates have been replaced by many small farms owned and worked chiefly by individual Indian cultivators. These people maintain their own animals for agricultural purposes. At present their animal husbandry is not good and except in a few cases no attempt is made to feed a supplementary ration to their working animals. There are probably more animals engaged in agriculture to-day than ever before, but for the above mentioned reason the consumption of maize by working animals has fallen off tremendously. The Indian cultivators were the chief maize producers; their market was to European controlled plantations; now these Indian cultivators are the plantation owners and except in a small way they are neither growing maize nor buying it for horse feed. By their failure to supply a better ration to their working animals they are thus destroying their chief market for maize. If this folly could be pointed out to these people and if they could be encouraged to go in for greater supplementary feeding of their working stock not only would the condition of their horses improve, with resulting better work, but also a greatly increased market would be created for the disposal of their maize and this crop once more would become a satisfactory money crop.

This Journal probably never reaches the Indian agriculturist, but there are many people who read the paper who are in close contact with them and if through these people Indian cultivators could be exhorted to feed a better ration to their working animals, better work and increased consumption of maize would result.

Maize cultivation should be as formerly, a chief crop of those small farmers not dependent on cane cultivation. Their chief market for maize should be to cane growers.

## HIDES FOR EXPORT.

By

C. R. TURBET, B.V.Sc., M.R.C.V.S.
Senior Veterinary Officer.

PRACTICALLY every vessel which leaves for Australia carries away a small consignment of hides. That these shipments are remunerative is evidenced by the fact that one seldom hears the export of hides discussed, evidently it pays the shippers and that is the end of it.

The collection of hides for export, however, is not well organised and there should be a considerable increase in the number exported. It appears that the butchery businesses have their business well organised for the export of hides derived from their slaughter houses but it is not in respect of these that complaint is made, but more particularly in respect of hides derived from cattle killed on plantations.

On an island like Taveuni for instance there must be at least 20 head of cattle killed per week. Apparently all these hides are wasted. It is suggested that exporters of hides should establish agencies in country districts for the collection for export of hides of plantation killed cattle.

Furthermore, statistics indicate that some £2,600 is annually spent in this Colony on the import of leather for local purposes while in addition the imports of manufactured leather goods exclusive of footwear amounts annually to approximately £5,000. These figures would indicate that there should be an opening in Suva for a small tannery.

## PIG SUPPLIES IN SUVA.

By
C. R. TURBET, B.V.Sc., M.R.C.V.S.
Senior Veterinary Officer.

Now that pig breeding for the supply of pork to the various butcheries in Fiji is being better organised, the time is drawing nigh when the local market will be fully supplied by pigs bred in Fiji. This is as it should be.

It appears, however, that certain breeders in anticipation of supplying this market have entered into contracts with the butcheries for the supply of pork. Anticipating that the supply will soon be more than is required, local buyers have established the practice of issuing contracts to the producers. In one instance a contract has been given far in excess of what the supplier is at present able to supply with the result that it has been necessary for this particular supplier to import pigs from overseas to fulfil his contract, whilst on the other hand some local producers are unable to sell pigs because they have no contract.

This state of affairs does not appear to be in the best interests of the farming community and it is suggested that producers should get together with butchers and come to some workable arrangement which would ensure that all producers have an opportunity of participating in the local pork market to obviate the necessity of having to import pigs from overseas for slaughter.

## TUBERCULOSIS IN SWINE.

By
H. M. STUCHBERY, B.VSc.
Veterinary Officer.

ALTHOUGH in the routine of meat inspection in Fiji it has always been notices that tubercular lesions are fairly common amongst pigs that have been reared locally, it has been assumed that most of the affected animals have incurred their lesions through the ingestion of infected milk. While this is still true of the majority of tubercular infected pigs in this country, it was found in one piggery that direct infection was apparently the means of the spread of the disease. At this piggery it was reported early in 1934 that heavy losses were being sustained among the swine. As it was reported that an imported boar had on post mortem been found to be suffering from severe lesions of tuberculosis this disease was suspected of causing the losses. A post mortem was performed upon another sick pig and again severe lesions were found in this animal. As no milk was fed to this herd and only cooked meat given, it was assumed that the infection must have been spread directly from one animal to another. As the infection seemed to be fairly general it was decided to tuberculin test the remaining breeding sows and segregate the non-reactors from the

remainder of the herd which were as opportunity arose, slaughtered. By these means and a thorough disinfection of the sites, &c., it was hoped that a fairly clean lot of pigs would result.

The test decided upon was the double intradermal test similar to that used in cattle, which test has been regularly used in Fiji for the past four years. The site chosen for the inoculation was a point on the neck about three inches behind the left ear. After clipping the hair from a patch about three inches in diameter, this was sterilized with tincture of iodine and one-tenth c.c. of old tuberculin injected into the deeper skin tissue. After 48 hours a similar injection was given, a final inspection being made about 24 hours later when the nature of the reaction was determined. Where positive reactions occurred it was noticed that the swellings were always fairly large being from 20 m.m. to 70 m.m. in diameter, very painful to touch and rather tense. This latter condition was attributed to the natural firmness of the skin in this region. Another feature noticed was that the majority of reactors appeared quite indisposed while undergoing the test, many of them refusing to take food. No such indisposition occurred amongst non-reactors. It was also noticed, especially in white coated pigs, that the skin above the site of the reaction in positive cases was of a dull brick-red colour. Of this herd, out of the eleven remaining breeding sows, five reactors were detected whilst later on in the year the breeding animals of another herd was tested and of 32 animals, seven gave positive reactions included in which was another imported boar. On post mortem it was found that all these reactors had lesions of tuberculosis.

In May, 1935, after similar losses had been reported from another piggery, it was decided to perform the tuberculin test on these animals. Here again tuberculosis was found to be very prevalent, fifteen reactors being detected out of twenty-nine animals tested.

With the two latter herds, it was found that a similar type of reaction developed as occurred in the first mentioned herd, also the fact that practically all reactors showed definite signs of illness.

In the last mentioned herd, it was reported that the first noticed case of illness occurred in an imported boar which was found to be tubercular on post mortem. As the disease appeared to be so rampant in the latter herd, it was decided to take steps to eradicate the disease. All the non-reactors were therefore separated from the other swine and a separate part of the sty was thoroughly disinfected before these animals were put into them. It was possible to carry out a thorough disinfection as the sties were well built with concrete floors, whilst the superstructures were chiefly iron. The walls, roof and floor were first thoroughly scrubbed down with hot water and cresol. Then a lime wash was applied containing one per cent. cresol, whilst the floors were coated with a thin coat of cement also containing one per cent. cresol. An unoccupied disinfected sty was maintained between the affected and unaffected pigs. The remainder of the pigs (reactors and untested animals) were to be slaughtered at the earliest convenience. Of six slaughtered reactors seen, all had tuberculosis in varying stages.

As these animals were slaughtered the sites occupied by them were to be disinfected in a similar manner to that mentioned previously. It is also proposed to repeat the test six months from the date of the first test in an endeavour to thoroughly clean the herd of tuberculosis.

It would appear that this test is a valuable diagnostic agent for tuberculosis in swine, but it is hoped that in the near future an opportunity will occur to test a number of swine intended for slaughter purposes. By the examination of the carcases of these animals after slaughter, an estimate of the reliability of this test to detect all reactors will be obtained.

## PARASITIC INFECTION OF THE LEG AND FOOT OF A DOG.

By
H. M. STUCHBERY, B.V.Sc.
Government Veterinary Officer.

ABOUT the end of July a dog was brought to the Veterinary Laboratory with a history of acute lameness accompanied by swelling in the left hind leg.

Examination revealed that there was considerable firm painful swelling of the limb as far up as the hock joint. The dog carried the foot off the ground all the time whilst on its feet and every now and then drew the limb right up to its body as though in acute pain. It was noticed that there were a few pinpoint breaks in the skin between the pads of the foot and just above the foot. It was thought that the condition was a grass seed infection and was treated accordingly.

A few days later the swelling in the limb suddenly became very much larger. The pin point breaks in the skin became much enlarged and discharged considerable pus-like material, whilst the pads of the foot began to slough.

On cleaning up the foot, a worm about eight inches in length was found coiled up in the region under the main pad of the foot whilst another was found lying in the connective tissue at the posterior aspect of the leg. This worm was similar in size and appearance to the previous one.

The dog was destroyed about two days later and a search made for further parasites in the affected region but none were found.

The worm was tentatively identified as the heart worm *Dirofilaria immitis* but this awaits confirmation. The heart worm of the dog is reported to have been occasionally found in unusual regions in the body.

This observation would appear to be the first made in Fiji of the occurrence of a filarial worm in the subcutaneous tissues of a dog.

## EXPORT OF HORSES FROM FIJI TO AUSTRALIA.

By
C. R. TURBET, B.V.Sc., M.R.C.S.
Senior Veterinary Officer.

IT will be of interest to horse breeders in Fiji to know that horses may now be exported from this country into Australia without quarantine on arrival in Australia. The following are the requirements in the way of certificates which would be necessary to send with the horse:—

(*a*) A declaration by the owner of the animal stating:—
  (i) that the animal has been free from disease during the next preceding six months prior to shipment;
  (ii) that it has not been in contact with any animal suffering from disease during that period.

(*b*) A Certificate by a Government Veterinarian certifying:—
  (i) that the animal is free from disease;
  (ii) that during the six months next preceding shipment no horse, ass or mule was imported into Fiji from any country other than Australia, New Zealand, Great Britain, Northern Ireland, Irish Free State, Channel Islands, Canada or the United States of America;

(iii) that he applied the Mallein test with negative result.

Where the Chief Quarantine Officer at the port of landing in Australia is satisfied that the vessel on which the horse imported from Fiji was carried did not carry any animal between intermediate ports on the current voyage it shall not be necessary for that horse, ass, or mule, to be conveyed to a quarantine station unless the Quarantine Officer suspects that the animal is suffering from a disease.

## ANIMAL IMPORTATIONS 1935.

INCREASING prosperity of the Colony is evidenced by the greater number of breeding animals imported in 1935. The following animals have been admitted:—

| | | | |
|---|---|---|---|
| January | 5 | 1 Berkshire Boar . .. .. | C.S.R. Company, Lautoka. |
| May | 24 | 2 Shorthorn Bulls and 3 heifers. | J. L. Hunt, Rewa. |
| June | 19 | 2 Sows .. .. .. .. | Leylands, Suva. |
| ,, | | 1 large white Boar .. .. | Morris Hedstrom, Suva. |
| July | 6 | 2 Zebu Bulls .. .. .. | C.S.R. Company, Lautoka. |
| August | 15 | 1 Friesian Bull, 1 Cow and 1 Calf | A. H. Witherow Esquire, Rewa. |
| ,, | | 1 Shorthorn Bull . .. .. | Williams, Tailevu. |
| September | 4 | 2 Sows .. .. .. .. | Morris Hedstrom Ltd., Suva. |
| October | 9 | 7 Thoroughbred Mares .. .. | D. B. Costello, Suva. |
| October | 14 | 1 Suffolk Punch Stallion .. | P. Costello, Suva. |
| November | 2 | 6 Shorthorn Heifers .. .. | C.S.R. Company, Lautoka. |
| December | 10 | 1 Tamworth Boar & 10 Berkshire | |
| | | — Sows .. .. .. .. | C.S.R. Company, Labasa. |

Total, 42 animals.

## PRODUCE MARKETING NOTE.

By

A. B. ACKLAND.
Acting Produce Inspector.

EFFORTS are being made to establish markets for various Fijian produce both locally and outside the country and though there are many difficulties to be encountered fair progress has been made with some commodities. Special efforts are in progress to bring about banana sales in bunches as well as in cases and to date this year, 14,062 bunches have been sold in Canada and 1,785 bunches in Sydney. In addition 132,435 cases of bananas have been satisfactorily marketed in New Zealand.

Amongst other products which are being marketed mention may be made of 2,997 cases of oranges, 5,793 cases of mandarins, some hundredweights of tobacco, 6,000 cigars, also kumalas, maize, yams and dalo.

## MYCOLOGICAL NOTES—MORTALITY IN LARVAE OF TELEONEMIA LANTANAE.

By
B. E. V. PARHAM, M.A.
Assistant Agricultural Officer (Pathology).

SINCE the introduction by H. W. Simmonds in 1928 of *Teleonemia lantanæ* for the purpose of biological control of *Lantana crocea*, the high rate of mortality of larvæ and adults has been recorded on several occasions. (Simmonds, *Agricultural Journal* Volume 2, No. 1, 1929).

This mortality has been shown to be partly due to insect predators; and recently another factor has been recorded which may account for a proportion of deaths. In October, 1935, R. Fyfe during his investigations of *Teleonemia lantanæ* found that the final instar larvæ and adults were commonly attacked by an entomogenous fungus which he kindly submitted for examination and determination.

The fungus proved to be a species of *Hirsutella* very similar in general characteristics to *H. citriforme*, Petch, which has been recorded in Ceylon, New Zealand and elsewhere (Petch, *Journal British Mycological Society*).

The parasitised insects are fastened down to the leaves of the Lantana by rhizoidal hyphæ and at maturity the fungus forms a tuft of sporiferous synnemata radiating from the body of the host.

The writer wishes to thank Mr. Fyfe for the opportunity of examining this fungus.

## TOMATO WILT.

By
H. W. SIMMONDS, F.R.E.S.
Government Entomologist.

FOLLOWING upon the notes on this disease published in the last number of this Journal the writer decided to attempt to grow tomatoes in pure broken soapstone. To this end the soil was removed over a given area and the underlying rock broken up, with additional broken soapstone added on top. This was turned over about twice and at the end of six months was considered sufficiently weathered to be used.

A small quantity of superphosphate, about one ounce per plant, was added to the soil and a row of Suttons " Satisfaction " tomatoes planted out. Sulphate of ammonia, one ounce to the gallon of water, was watered in three times during the growing season.

No wilt developed and all the plants gave heavy yields of large size fruit. Whether the absence of wilt was due to the alkalinity of the soil or the absence of the bacterium is, of course, a question, but it offers a means of utilisation of the bare patches of soapstone around Suva, at no great cost.

## ENTOMOLOGICAL NOTES.

By
H. W. SIMMONDS, F.R.E.S.
Government Entomologist.

*Levuana iridescens*, Beth. Bak.—An outbreak of this pest was recorded early in the year, on coconuts growing in the Wainamala Valley. It was quickly suppressed by the introduced parasite *Ptychomyia remote*, Ald.

*Promecotheca reichei*.—An outbreak of this coconut pest is reported from Vanua Balavu in the Lau Group, but appears to have come under parasitic control.

*Teleonemia lantanæ*, Dist.—A colony of about 300 of this introduced enemy of lantana was despatched to the New Hebrides early in October, whilst another colony, of about 1,000, was despatched to New Caledonia in November. The latter arrived in good condition.

*Tetrastichus giffardiarius*, Sily.—Colonies of this recently introduced (from Hawaii) fruit fly parasite have been despatched overseas as follows:—

| | | |
|---|---|---|
| New Hebrides .. .. .. | 500 | October |
| Western Samoa .. .. .. | 250 | November |
| New South Wales .. .. | 350 | ,, |
| New Caledonia .. .. .. | 700 | ,, |

*Apantcles tirathabæ*.—Small colonies of this parasite of the coconut spike moth *Tirathaba trichogramma* were despatched in October and again, in November, to Apia, Western Samoa.

*Nemeritis palmarum*.—A small colony of this species, parasitic upon the same pest, was despatched in November to Western Samoa and a second, larger consignment, is now being prepared for shipment.

*Papuana lævipennis*.—Complaints of damage to taro by the grub of a beetle on Tarawa in the Gilbert Islands proved to be due to the above Dynastid beetle. This species, previously known from the Solomon Islands only, is apparently a recent introduction and is proving a most disasterous pest, completely destroying all taro on the island.

## SOME PRELIMINARY OBSERVATIONS ON CITRUS AURANTIUM AS A CITRUS STOCK IN FIJI.

By
H. R. SURRIDGE, A.R.C.Sc.(I).

*Citrus aurantium* known as sour orange, Seville and Florida sour, is the stock used for the production of more than 75 per cent. of the world's output of citrus fruits. Its popularity is due primarily to its immunity to *Phthiacystis gummosis* and other citrus diseases, secondly to the better quality of fruit said to be produced by scions on this stock. It is in common use wherever citrus is cultivated with the exception of South Africa where, for reasons not yet known, it has proved a failure.

In Fiji, citrus culture is in its infancy, hence the following brief notes are recorded to add to the general knowledge of this orange for stock purposes.

Sowings of seed of *Citrus aurantium* were made in 1933 at the Nasinu Citrus Research Station, of these the best were transplanted into a nursery for subsequent budding.

Buddings of Marsh Grape Fruit and the following sweet oranges:—Nasinu, Valencia Late, Parramatta and Mediterranean Sweet, were made in January, 1934, on to these stocks as well as on to the sweet orange (*Citrus sinensis*, Osbeck) stocks. Growth and maturity differences are striking.

In all cases, buddings on to the sweet stock average six feet six inches in height, are strong healthy trees, but have not shown flowers or fruit.

In the case of the sour stock, no differences are yet observable in the Marsh Grape Fruit.

With the sweet orange buds on the sour stock the following differences appear:—

(1) A tendency to separate into tall and dwarf trees, dwarfs averaging one foot five inches to one foot nine inches according to variety, while talls average two feet eight inches to three feet five inches.
(2) Dwarf trees show yellowing of all leaves, while talls are generally a light green.
(3) Earlier fruiting, fruit and flowers produced on both dwarfs and talls.
(4) Complete incompatability displayed by certain buds, shown by a restricted growth and subsequent die back.

Details are as follows:—

| | | | | | | |
|---|---|---|---|---|---|---|
| Valencia Late .. | 24 | dwarf | average height | 1 ft. 9 in. | 1 | fruiting |
| | 39 | talls | ,, | 3 ft. 5 in. | 5 | ,, |
| Nasinu .. .. | 36 | dwarf | ,, | 1 ft. 9 in. | 2 | ,, |
| | 16 | talls | ,, | 3 ft. 3 in. | 5 | ,, |
| Parramatta .. | 24 | dwarf | ,, | 1 ft. 6 in. | 2 | ,, |
| | 2 | talls | ,, | 2 ft. 8 in. | 2 | ,, |
| Med. Sweet .. | 35 | dwarf | ,, | 1 ft. 5 in. | 15 | flowered but no fruit set. |

It will be noted that no talls appear amongst the Med. Sweet buddings; it is not clear therefore whether differences in height are inherent factors or signs of degrees of incompatability.

A further difference noted is that, whereas Valencia Late and Med. Sweet have a spreading habit on sweet or rough lemon stocks, on the sour stock they are showing an upright habit. The normal habit of Parramatta and Nasinu, namely, upright, appears unaffected.

It is realised that no inference can yet be drawn from the observations here recorded, but the differences indicate the urgent need for long range stock trials carried to completion before final recommendations can be made. The work of R. Hatton, at the East Malling Research Station, England, with reference to apple stocks is the classical example of the type of work necessary to be undertaken with regard to citrus stocks and its necessity is demonstrated by the experience recorded from the Californian Lemon groves which did not show incompatability of stocks until established some 15-20 years.

## FIJI AGRICULTURAL SHOW.

THE D partment of Agriculture, as usual, took a prominent part in the local Agricultural Show which was organised by the Fiji Show Association and was held on the 14th October in Suva.

The Department, in addition, staged an exhibit of general agricultural interest to indicate the various lines of work which were being followed at the time.

The chief feature of the exhibit prepared by the Chemical Division was a collection of the main ores from the Emperor Gold Mine at Tavua which were kindly submitted by the Manager of the Mine.

On the same table the methods adopted in assaying ore samples were displayed and keen interest was shown by the public in this, the latest industry in Fiji.

Included with the agricultural general exhibit were a series of essential oils distilled from local plants grown at the Nasinu Experimental Station, also a small sample of cassava flour and cassava meal for which there are possibilities in the dextrine industry.

The Entomological Division staged an exhibit showing the two principal Fijian fruit flies (living) together with their most important native enemies. Colonies were shown of the newly introduced parasite *Tetrastichus giffardianus* and the methods adopted in breeding these species (host and parasite) in captivity were demonstrat d. Cases we e also displayed exhibiting a series of drawings illustrating the anatomy of the flies.

The Agricultural Division staged several exhibits of which coconuts, tobacco, cotton, various economic plants and food crops were the main features.

In connection with the copra industry the exhibit comprised samples of good and of bad copra judged by standards of marking on points which determine the quality of the copra. A model copra kiln suitable for small holders was also on show and indicated the simplicity of construction required to erect kilns that can, with ordinary, but regular, attention produce excellent quality copra.

In addition a number of the by-products of coconut cultivation were staged, including fibre, fibre rope, matting, charcoal, timber, brushes, oil, dessicated coconut, meal and fresh nuts graded for export.

In the tobacco section, types of leaf suitable for wrappers and for filling cigars were shown as well as a display of cigars made from different tobacco wrapper types. In addition the developing of "stick" trade in tobacco for native consumption was emphasised by a show of cases ready packed and marked for export as well as other open cases to permit of examination of the actual "stick."

As regards cotton, the exhibit consisted of bales of Sea Island and Fiji Hybrid cotton ready for export. Piles of seed cotton, lint, cotton seed oil and meal were staged in addition to a series of cases in which the selection of the chief economic hybrid type was indicated. Combed seed cotton of a number of other varieties were also shown in cases and attracted considerable attention.

Some of the work of the Produce Inspection Division was illustrated by the operation of machine grading of oranges which was in action periodically for the duration of the Show and formed a centre of much interest.

Methods of budding citrus trees was also a feature of intetest, the operations being demonstrated frequently on a collection of potted citrus seedlings. Decoration was assisted by a collection of potted flowers, plants and trees which are grown by the Department for sale locally.

General agricultural produce was well represented by bunches of bananas, cased bananas ready for export, tapioca roots and flour, pineapples, yams, dalo, derris roots, paddy, yangona, groundnuts, sweet potatoes, kauri gum, maize and maize flour. Bread made of wheaten flour mixed with 10 per cent. maize flour proved attractive, samples being given to selected spectators.

The Veterinary Division demonstrated a moveable model fowl house and run suitable for Fiji conditions. This embodied the features of being readily transported from one plot of ground to another, sanitary construction and protection of the birds from adverse weather conditions. Notices were placed on the structure indicating its salient features.

A model pig sty was also exhibited to demonstrate a reasonably cheap structure for raising healthy pigs. In addition, the usual exhibit of pathological specimens was on show as well as framed specimens of the grasses of Fiji. Finally the display of concentrate food stuffs available in Fiji with descriptions of their feeding value was also staged.

Officers of the Department assisted in the erection of District and Provincial stalls, with arrangement of the exhibits thereon and with the judging of the various competitive agricultural sections.

In the competitive sections of the Show special mention may be made of the excellency of the winning Provincial Exhibit (Naitasiri) the winning District Exhibit (Davuilevu) and of the copra samples sent in by Estates. With regard to the later, eleven Estates participated and some of the samples were very good while others were decidedly poor indicating that drying had been insufficient. The samples were all judged according to a system of points devised to give proportional weight to the chief factors which affect the quality of copra namely, oil content, moisture content, cleanliness, appearance, acidity and smell.

With the exception of the copra, all the exhibits in the competitive section were entered by Fijians.

## THE LANTANA BUG IN FIJI.

By

R. V. FYFE, B.Sc.Agr. Division of Economic Entomology.
Council for Scientific and Industrial Research Commonwealth of Australia.

FOR some time it has been recognised that, in Fiji, certain environmental factors have been effectively operating against the increase in numbers of the Lantana bug, *Teleonemia lantanæ*. The writer has made an attempt to identify and to evaluate the importance of the ecological factors responsible for limiting the activities of this insect in Fiji before attempting its introduction into Australia.

Observations extending over a period of five years, made by Mr. Simmonds, have shown that there is a marked seasonal variation in the effect of *Teleonemia* on *Lantana*. The bushes are apparently much more heavily infested and more damaged by the bug during the cooler and drier season of the year.

During the warmer and wetter months of the year, *Lantana* appears to be much more lightly attacked, partly because of the fact that during this season the bugs characteristically migrate to and concentrate on the inflores-

cences while during the winter it is the vegetative part of the plant which is attacked. Colonies of bugs feeding upon the leaves cause a much more spectacular type of damage than that caused by the more insidious feeding on the individual florets which leads to a smaller seed production.

In spite of the effect caused by the movement of the bugs from the leaves, it appears that such adverse climatic and biotic factors as are operating, are working with maximum intensity during the summer months.

Of prime importance seems to be the Lygaeid bug, *Germalus pacificus* (Simmonds, this Journal, 1929). While this bug is to be found on *Lantana* all the year round, it breeds up in large numbers in spring when the flowers and fruits become more abundant. It also feeds on the florets and fruits and so comes into more direct contact with whatever *Teleonemia* nymphs are on the flowers during this season.

*Teleonemia* is attacked in the field under humid conditions by an entomogenous fungus identified by B. E. V. Parham of the Fiji Department of Agriculture as *Hirsutella* sp. Not only are adult bugs attacked but also 5th instar nymphs which likewise succumb to a similar infection. The parasitised insects are first firmly attached to the stems or leaves by undifferentiated hyphal rhizoids which push through between the ventral sclerites of the thorax. Later, bundles of conidiophores, the synnemata, grow out from the dorsal surface. These are white and simple at first but usually become brown and branched with age and extend to a length of approximately 2 cm. if conditions have remained humid.

Other enemies observed actually attacking *Teleonemia* in the field included adult Ladybirds of the species *Coccinella transversalis* and Neuropterous larvae of the genus *Hemerobius*. These predators, however, seemed to be of very little importance on account of their very infrequent occurrence on *Lantana*.

Observations on the effect of heavy rain have shown that torrential rains are responsible for a reduction in the numbers of *Teleonemia* nymphs. The feeding of a colony of bugs on a single leaf causes a yellowing of the leaf accompanied by a response on the part of the plant which leads to the formation of an abscission layer at the base of the petiole. When a leaf bearing a colony is in this condition, the advent of torrential rain leads to a further reduction in the number of bugs by knocking the leaf and the bugs to the ground. Where the bushes are old and the leaves well above the ground the nymphs cannot return to their food and soon die.

In the present state of our knowledge it appears that we have to ascribe the inability of *Teleonemia* to increase in numbers and so increase its range to the following factors:—

(1) The activities of the predatory bug, *Germalus*.
(2) The presence of an entomogenous fungus which is able to develop rapidly under humid conditions and to spread by taking advantage of the gregarious habits of the bug.
(3) The mechanical effect of torrential rain.

The writer has also observed the Lygaeid bug, *Germalus pasificus*, feeding upon the nymphs of two other unrelated insects, vix. *Brachyplatys pacificus* Ball, a small black Pentatomid and a *Pseudococcus* Mealy bug which occurs in small numbers on *Lantana* in the Suva district.

## AVERAGE MARKET PRICES IN DECEMBER, 1935, OF PRINCIPAL AGRICULTURAL PRODUCTS OTHER THAN SUGAR.

By
A. B. ACKLAND.
Acting Produce Inspector.

| | | | |
|---|---|---|---|
| Copra | Suva | £9 10 0 | per ton |
| Rice | ,, | 16 0 0 | ,, |
| Paddy | ,, | 9 0 0 | ,, |
| Taro | ,, | 3 0 0 | ,, |
| Yams | ,, | 7 0 0 | ,, |
| Bananas—New Zealand | ,, | 4s. to 4s. 6d. | per case |
| New South Wales | ,, | 4s. to 4s. 6d. | per case |
| New South Wales | ,, | £0 1 9 | per bunch |
| Pineapples (fresh) | ,, | 0 2 6 | per case |
| Maize (grain) | ,, | 0 10 0 | per bag |
| Kumalas | ,, | 0 6 0 | per bag |
| Kumalas | New Zealand | 0 14 0 | per bag |
| Tobacco Leaf | Suva | 0 0 6 | per lb |
| Kauri Gum (first grade) | ,, | 18 0 0 | per ton |
| Cotton, Sea Island | London | 0 1 6 | per lb |
| Cotton, Egyptian | ,, | 0 0 7½ | per lb |
| Pawpaws | New Zealand | 0 10 0 | per case |
| Granadillas | New Zealand | 0 11 6 | per case |

# AGRICULTURAL JOURNAL

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## EDITORIAL.

THIS number of the *Journal* contains a record of the importation into Fiji of the giant toad which appears to find conditions congenial since it is breeding and spreading satisfactorily. Toads can now frequently be seen and heard in the evenings in the neighbourhood of the areas where colonies have been liberated and already reports have been received of their beneficial action.

The beneficial effects of lime in most tropical soils is generally admitted and the Government Chemist, in a concise article, clearly indicates the chief means by which lime ameliorates our soils in Fiji. He also mentions that the need for lime in Fiji soils was pointed out by the Department of Agriculture as early as 1916, and that recent experimental work showed definitely the beneficial action of lime in reducing the acidity of alluvial surface soils. The mechanical action of lime in soils is commonly recognised but the more important effect of lime in rendering plant nutrients in the soil the more available to crops might be better known. Fiji is fortunate in possessing an abundance of lime in the form of coral sand, the action of which may be accelerated by crushing it finely before application to garden soils.

An article on small copra driers is the most important feature in this number of the *Journal*. The Department of Agriculture is making a strenuous effort to improve the standard of Fiji copra, which, up to the present, has not enjoyed a good reputation and has in consequence commanded poor prices compared with some of the chief copra-producing countries. The type of kiln described in this number is simple in design, cheap in construction, free of fuel costs, easy to operate, independent of weather conditions and capable of turning out really first class copra and hence should prove a considerable boon to the Colony.

South Seas copra prices month by month from January, 1934, to September, 1936, have been priced in the world's market at an average of 14s. 2d. per ton less than Rabaul copra, at £1 3s. 8d. per ton less than Malayan copra and at £2 per ton less than Ceylon copra.

Thus South Seas copra is definitely inferior, chiefly because its manufacture is largely dependent on uncertain weather conditions.

This unsatisfactory situation is capable of being remedied and in fact must be remedied since it is possible that a time may come when bad copra will be unsaleable in competition with copra of better quality and with several other oils with which coconut oil is now interchangeable. The divergence in price between good and bad copra tends to be reduced when high copra prices prevail but general circumstances appear to indicate that, except when special circumstances arise, the average price of copra

over a long period is likely to be materially lower than it is at the present time (£14 per ton in Fiji). Hence the prospects are that there will be a material difference between the average prices realised for good and for bad copra over the next ten years, therefore no opportunity of improving the quality of the Fiji product should be missed.

Approximately 60 per cent. of the copra exported from Fiji is produced by small holders, mostly Fijians, therefore efforts in the first place are being mainly confined to this section of the producers who are annually responsible for the production of some 18,000 tons of copra. There is no reason why Fiji copra should not command prices at least equal to those paid for Rabaul copra, if not for Malayan copra, and if the average price of the small holders' product can be raised by 15s. per ton this would result in an increased circulation in the Colony of some £13,000 each year. This sum would be raised to over £20,000 per annum if similar improvement is extended to all estate-produced copra and this does not appear to be beyond the bounds of possibility if some form of grading can be adopted, so as to furnish the incentive provided by increased returns which would undoubtedly result if large consignments of good grade copra could be shipped.

Naturally, general improvement in grade is fraught with many difficulties but similar difficulties, economic and temperamental, have been overcome in other countries and the present apparent and welcome desire of the Fijians for improved economic conditions should assist in making gradual progress in the right direction.

Tobacco culture is being given increasing attention by the Department in the last 18 months and useful information on tobacco growing, harvesting and curing is contained in this issue. During his furlough, Mr. W. L. Parham took the opportunity of gaining much valuable information regarding the handling of this crop in Canada, and his notes and experiences will be very helpful in the development of this industry in Fiji. Mr. D. A. Donald has successfully carried out valuable experiments with harvesting, curing and fermenting of tobacco in the Colony and his results indicate that with certain modifications the Fijian " bure " can be admirably adapted for the satisfactory treatment of tobacco leaf suitable for cigar filler and wrapper purposes. It might be mentioned that varietal trials of some 30 types of tobacco are also in progress with a view to a decision as to the best two or three types suitable for local conditions and local purposes.

Efforts to resussitate the cotton industry locally are in operation and though these efforts are strongly discounted by the more attractiveness of sugar cane and rice, certain small sections of the people appear to be definitely interested and in this *Journal* Mr. B. L. Field records some of the difficulties encountered in buying seed cotton and in ginning it. The recent adoption of single unit ginneries and the reduction of four grades for seed cotton to two grades in the last buying season have already shown that cultivators appreciate these changes.

Fiji has been most fortunate in the phenomenal success which has been achieved in the matter of control of insect, and even plant, pests by biological methods as evidenced by control of the Levuana pest of coconuts and of the weed commonly known as the " curse " (*Clidemia hirta*) and in this issue a belated article appears as a record of research dealing with the Leaf Miner pest of coconuts. In this article Mr. Taylor indicates the habits of this pest, the nature of its damage to the palms, its natural enemies, the cause of outbreaks, the selection of a suitable parasite to control the pest and finally the successful results achieved by the introduction of the larval parasite *Pleurotropis parvulus*, Ferr.

The modern means of detection of water added to milk are outlined in an interesting article by Mr. Blackie and it may be mentioned that the Hortvet Cryoscope has already proved itself a valuable weapon which will do much to prevent the pernicious practice of diluting milk used for domestic purposes.

It is not generally realised that this Colony carries some 12,000 horses. These require proper feeding and care if they are to give their best value to their owners and hence Mr. C. R. Turbet contributes a lucid account of the various necessary food constituents which should prove of utility and of interest. He stresses the need for a balanced nutritive ratio if full value is to be obtained from the various available foods, gives the best proportions to adopt in utilising the chief local feeds and mentions that "little and often" is wisely applied to the feeding of working horses.

A possible potential crop for Fiji is indicated in notes regarding arecanuts or betel nuts. These palms are easily grown, cost little in maintenance after the first few years and have a long cropping life. While the chewing of "betel" is not so common as in the Eastern tropics—possibly because the Indian can always afford to buy tobacco—still the indications are that more would be utilised if local supplies were available since over 20,000 lb of the prepared nut are imported annually into the Colony. Also, there is little doubt that a small export market could gradually be built up should a surplus of production become available.

Another potential crop for small holders in sheltered localities is the candlenut. This tree is found in isolated patches in general distribution through the Group and every effort is being made to find a market for the oil. Candlenut oil was formerly much in use but has latterly been replaced by tung and linseed oils, largely, it is thought, because supplies of the former were irregular.

Much experimental work has been done in connection with the adoption of suitable methods for the treatment of the crop and these experiments are lucidly compiled in this number by Mr. Blackie who draws interesting conclusions from the results up to date.

In addition to the articles mentioned several useful general, entomological and veterinary notes are found to complete this number of the *Journal*, which should be read with much interest.

## THE GIANT TOAD (*Bufo marinus*).

By
H. W. JACK, M.B.E., B.A., D.Sc.,
Director of Agriculture.

THE Department of Agriculture first became interested in this amphibian early in 1933 when the Government Entomologist, Mr. Simmonds, who had made the acquaintance of the species in Trinidad, initiated inquiries into its feeding habits, hoping it might prove of value, as a general predator, in controlling slugs, beetles and millepedes, if introduced into Fiji.

Early replies suggested delay, pending futher information. There has, for many years, been a strong feeling in entomological circles against the introduction of vertebrates into new countries, largely due to the unfortunate and ill-advised introduction made into the Australian Colonies by the early settlers.

In 1934 Hawaii became interested in the animal and it was introduced into that Group, where it very rapidly increased in numbers. From Hawaii a colony was taken to Queensland, where, it is understood, some were released. This action aroused severe criticism and further liberations were stopped.

Following the report of the introduction of the toad into Hawaii the question was asked in the Legislative Council (November 1935) " Will the Government give early consideration to the introduction of toads into Fiji, the introduction of which into Queensland and Hawaii has been so successful?"

To this the Government replied that " inquiries regarding the advisability of introducing the giant toad into Fiji for insect control were initiated in 1933, when the concensus of scientific opinion was that action should be postposed for a time. Further inquiries have since been made and should replies prove satisfactory the introduction of the toad will be undertaken."

Meanwhile records of stomach analyses had been coming to hand and these showed that beetles formed a considerable proportion of its food, and from Jamaica one record showed an average of 9·9 banana borers per toad. In view of these valuable records and the fact that no serious cases of the destruction of useful species were shown, in December 1935, the Department decided to make the introduction and hence 67 half-grown adults were imported from Hawaii through the courtesy of the Entomologists of the Hawaiian Sugar Planters' Association. These arrived in Fiji early in February, 1936.

In co-operation with the Colonial Sugar Refining Company, Limited, these were kindly taken over by Mr. Windred, Entomologist to that Company, who prepared a suitable breeding place at Lautoka. Breeding commenced at once and in April a colony was received in Suva. This colony was not a success having apparently been exposed to heat *en route* and were mostly dead on arrival. Further colonies received in May and June, however, arrived in splendid order and were released in Suva, Nasinu and Navuso. These are now frequently to be seen and heard in the evening.

Toads require still water in which to breed and will travel considerable distances to find it. It is important that they be allowed to concentrate in sufficient numbers to permit mating and the public are requested not to try to place them in their own gardens until their numbers have increased sufficiently to ensure permanent breeding.

Already reports of beneficial action by toads have been received from several sources and it is anticipated that they will prove a profitable addition to the fauna of Fiji.

## LIME AS A SOIL AMELIORANT.

By

W. J. BLACKIE, M.Sc., F.N.Z.I.C., A.I.C.,
Government Chemist.

CERTAIN substances are added to soils, not in the capacity of fertilisers which supply essential plant foods, but for the purpose of improving production through their influence on the physical properties of the soil and thus the chemical and biological properties.

Among this class of substance we include calcium in the form of carbonate, lime, or slaked lime. Calcium is an essential plant food but most soils contain a sufficiency of this element for normal plant requirements and it is seldom that there is a necessity for its addition to supply plants directly.

Fiji soils vary much in their physical and chemical properties but there are a few characteristics that are common to most of them as being distinct from soils of European origin. In the first place they are remarkably deficient in carbonate of lime which is absent in the majority of cases and in the second place they are generally low in phosphoric oxide which in many cases has a negligible availability. This, no doubt, is due, in the case of lime, to the excessive leaching under humid tropical conditions and the low availability of phosphate is to be ascribed either to its fixation as aluminium and iron phosphate or its absorption by the colloidal complex of the soil.

The beneficial effects of lime can be considered under the following headings:—

(1) Effect on tilth and bacterial action.
(2) Liberation of plant food materials.
(4) Effect on toxic substances and plant diseases.

(1) On clay soils lime has the effect of flocculating the dispersed particles which are then held together by the cementing action of calcium carbonate. By this means the crumb structure of the soil is improved and on heavy clays, tillage operations are assisted, drainage is facilitated and the soil is opened up to the atmosphere. In general, root development and bacterial action is facilitated by the improved soil conditions. With sandy soils calcium carbonate helps to bind the soil particles together making a somewhat firmer structure with a consequent increase in water holding capacity. Care, however, is necessary in regard to the application of lime to sandy soils since it has a tendency to increase the availability of potassium and probably phosphate which are the more readily lost from a sandy soil than from the clay type. A soil devoid of calcium carbonate is in a favourable condition for the development of acidity which may increase to such an extent as to be directly injurious to crops. There is also a greater tendency to lose nitrogen on light soils by excessive use of lime. when the neutralising effect of a base such as lime is used up, the more important bacterial actions concerned in the breaking down of organic matter and the conversion of its nitrogen into nitric acid is much hampered and it is probable that lime acts not only indirectly as a neutralising agent in these processes but also takes a definite chemical part in the reactions. The increased permeability to air induced by the flocculating effect also facilitates desirable bacteriological activity.

(2) Experimental work has indicated that there is a tendency for basic exchange to take place within a soil so that calcium may replace potassium and magnesium from the absorption complex. It is therefore readily

appreciated that by increasing the lime concentration on soils poor in available potash an increase in this important plant food may be occasioned and thus convert a soil deficient in available potash into a soil holding a sufficiency for the crop's need. Care, however, must be exercised in regard to sandy soils with low total potash. There is a good deal of evidence that under certain conditions, particularly with lateritic soils, phosphate may become locked up as iron or aluminium phosphate which is less soluble than tricalcic-phosphate in the soil solution. Or again it may be held tenaciously by the absorption complex of a soil. Evidence has been adduced to the effect that by supplying a base such as calcium a more soluble phosphate is formed and that liming a calcium carbonate deficient soil helps to render available some of this locked up phosphorous as well as preventing the locking up of applied phosphate fertiliser. Nevertheless experiments by D. Prianischnikov and Simmermacher and more recently by C. O. Williams in Natal tend to disprove this work although it must be admitted that there is considerable practical support for the theory. It is probable that both views contain a certain amount of truth and different results may be dependent on soil maturity or peculiar chemical conditions within a soil.

(3) It is well known that applications of calcium carbonate assist markedly in the promotion of the ammonification and nitrification processes that occur in soils. By an interesting series of processes organic matter is broken down in soils and a large portion of the nitrogen converted first to ammonia which is then oxidised to nitric acid. These processes are carried out by bacterial action which is retarded in the absence of a base like calcium carbonate which neutralises the nitric acid produced. The calcium nitrate formed is a suitable chemical compound for the supply to the plant of the essential plant food nitrogen. Any base would of course be satisfactory for this neutralising process but the addition of lime is the most economic method and is of great importance to crops which show a ready response to nitrate fertilisation. The absorptive properties of a soil for lime will determine the amount that should be applied. This can readily be determined in the laboratory by lime requirement methods or in the field by experimental trials. Kellerman and Robinson have indicated that for sandy loam soils a nitrate production was favoured by applications of lime up to 2 per cent. which is much in excess of normal requirements. Magnesium carbonate has a depressing action on nitrate formation and if this base is present in excess, that is above 0·25 per cent. the subsequent addition of lime would not ameliorate conditions.

(4) Free acidity in a soil has a marked effect in limiting production with most agricultural crops and promoting certain diseases such as "finger and toe" disease of the cruciferæ and Panama disease of bananas. It is to be noted, however, that certain crops such as tea favour acid soils and calcium carbonate application is injurious to such crops. Also the continued application of calcium carbonate to potato soils promotes the development of potato scab. Fiji soils are on the acid side with hydrogen iron concentrations varying from 4·6 to 6·3 Ph. Soils of the sandy loam type at the Navuso Agricultural Station possess Ph values varying from 5·3 Ph to 5·77 Ph and a lime requirement by the Hutchinson method of 0·22 to 0·26 per cent., that is the parts of lime required to be added to 100 parts of soil to satisfy the lime demand. These figures indicated the necessity for the addition of about three tons per acre of calcium carbonate and since chemical methods usually indicate a lower value than the actual requirement, five tons of calcium carbonate in the form of coral sand was directed to be added to each acre of the area concerned. In another experiment 20 tons was added to a

small area. Controls were kept for each block and the hydrogen ion concentration of controls and limed blocks determined after a period of 18 months when the values quoted below indicate the value of lime in reducing acidity:—

| Sample. | Treatment. | Ph. |
|---|---|---|
| Soil A .. .. .. | 20 tons per acre | 6·71 |
| Soil A Control .. .. | No treatment | 5·32 |
| Subsoil A .. .. | 20 tons per acre | 6·71 |
| Subsoil A Control .. | No treatment | 5·28 |
| Soil B .. .. .. | 5 tons per acre | 6·53 |
| Soil B Control .. .. | No treatment | 5·36 |
| Subsoil B .. .. | 5 tons per acre | 5·77 |
| Subsoil B Control .. | ,, | 5·77 |

These figures also indicate as far as acidity of the surface soil is concerned that applications of calcium in the form of coral sand at the rate of five tons per acre is effective on the sandy loams of the Navuso Agricultural Station. The hydrogen ion concentration was determined by the electrometric technique using the quarinhydrone electrode.

Similar results were obtained by C. O. Williams with soils in Natal. Applications of calcium carbonate at the rate of 1,500 lb ground limestone or calcite applied annually over a period of ten years showed Ph values of 5·9 on limed plots and 5·6 on the unlimed plots. In these experiments, however, results were influenced somewhat by artificial fertiliser and other treatment.

Lime may be applied to the soil either as burnt lime (Calcium oxide) slaked lime (Calcium hydroxide) air slaked lime (Calcium carbonate) ground limestone or calcite (Calcium carbonate) or as in Fiji, coral sand, which is also Calcium carbonate.

Quick lime or burnt lime and water slaked lime have a distinctly alkaline reaction and act rapidly in removing sourness. They are, however, soon converted either into insoluble forms or into the carbonate. The presence of a small amount of Calcium carbonate is a necessity in most soils and this component should not be allowed to fall below 0·5 per cent. Quick lime is useful in having a greater granulation effect on a soil and is therefore of value on heavy clay soils. It however has an adverse effect in assisting the loss of nitrogen from a soil and in using this variety for opening up clay soils it is better to incorporate frequent light doses.

Calcium carbonate in the form of air slaked lime has the advantage of being in a finely divided state and does not possess the adverse effect of burnt lime on organic matter. Its granulation effect on heavy clays is not so pronounced as burnt lime but crumb structure is improved over a period. Calcium carbonate in the form of ground limestone, ground calcite or coral sand should be finely ground to pass a sieve of at least 50 meshes to the inch. These forms of carbonate also are often impure and for agricultural purposes should contain 80 per cent. of calcium carbonate. Coral sand used in Fiji varies from about 80 to 94 per cent. calcium carbonate.

It might be mentioned that it was pointed out by Wright in *Bulletin* No. 9, 1916, Dept. of Agriculture, Fiji; and also in *Bulletin* No. 11, 1919, that Fiji soils were lacking in calcium carbonate. It is also worthy of note in 1921 the Colonial Sugar Refining Company adopted liming with coral sand as a fundamental soil treatment with highly beneficial results.

## SMALL COPRA DRIERS.

By
G. F. FLEMONS, Assistant to Government Chemist.
L. W. HARWOOD, H.D.A., Agricultural Officer, East.

TOWARDS the end of 1935, the Director of Agriculture, with a view to stimulating the artificial drying of copra among Fijian small holders, introduced the type of small copra drier which had already proved to be effective in Malaya. Climatic and economic differences, however, necessitated its modification for operation under Fijian conditions and the writers were instructed to carry out experiments designed to effect the improvements to suit local conditions.

From the climatic point of view it was found that owing to the constancy of the wind, especially in the copra producing districts, that the exposed drier was not suitable. For this reason the unit has been erected in a well constructed " bure " (native thatch house) having only one door and no windows thus insulating the actual kiln from the outside air. The effectiveness of this " bure " is well evidenced by the reduction in fuel consumption and the equalisation of temperatures in the copra chamber.

From the economic side it was appreciated that units having a large capacity would prove to be too arduous and expensive for the average small holder in this country. A compromise has, therefore, been effected and a drier, having a capacity of approximately 1,500 nuts, capable of producing a quarter of a ton of copra per drying has been standardised.

The essential features of this kiln are that its cost of construction is low; it is easy to erect; fuel costs are negligible; its thermal efficiency in relation to its cost and the supply of shell fuel is satisfactory and drying routine is simple and effective in assuring a good grade of copra.

The kiln is composed of two parts, the copra chamber and the combustion chamber, the latter incorporating the fire pit. The top (copra) chamber is separated from the botton one by wire netting supported on iron bars or rods to give it sufficient rigidity and is of the dimensions 6ft. by 6ft. by 2½ft. giving a capacity of 90 cubic feet. The depth of a charge consisting of 1,500—1,600 nuts, each split in half, is from 15in. to 18in. and the weight of the product, dried to a moisture content of 5—6 per cent. is approximately a quarter of a ton.

The combustion chamber is constructed with sloping sides as suggested by the Director of Agriculture. This improvement assists the rising hot air current since it is concentrated from a basal section of 8 by 8 feet to a top section of 6 by 6 feet. The baffle plate which ensures the even distribution of the heat is 6 by 6 feet, and is suspended horizontally one foot below the wire netting (half inch mesh) which forms the copra platform. The baffle plate has holes ¾in. to 1in. punched at intervals of four inches over its entire area, through which the rising heat is distributed uniformly. The hot air rising through the copra becomes charged with moisture and is dissipated through the roof of the " bure," aided by a little ventilation embodied in the structure of the " bure."

The principle of the drier is elementary but effective. Clean and dry half shells, obtained from the preceding dryings, are cupped one into the other and placed in a " worm " around the sides of the fire pit. These constitute the heating element. As can be seen from the plan, bottom ventilation pipes (bamboo or iron) are fitted and the warm air of the ' bure ' is drawn down these tubes to the bottom of the fire pit and thus quickly becomes heated. Moderate precautions (caulking) are taken to prevent the entrance of air at the other points of the combustion chamber.

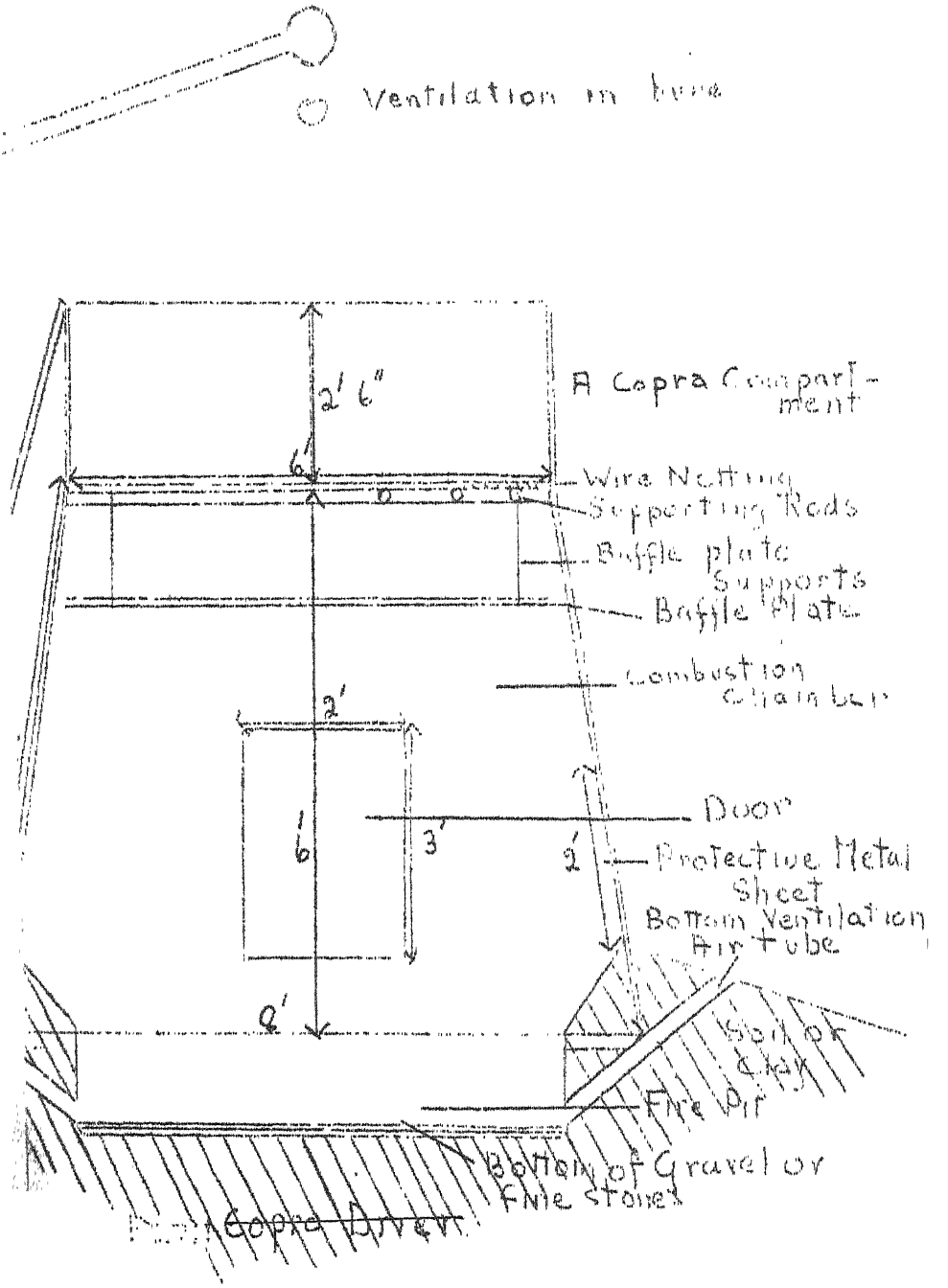
Ventilation in tube
2' 6"
A Copra Compartment
6'
Wire Netting
Supporting Rods
Baffle plate Supports
Baffle Plate
Combustion Chamber
2'
Door
1' 6'
3'
2'
Protective Metal Sheet
Bottom Ventilation Air tube
6'
Sort of Grate
Fire pit
Bottom of Gravel or Pnie stones
Copra Dryer

Diagram I.

From the above considerations it is evident that the "bure," plays a large part in the efficiency of the kiln. The "bure" should be erected in a carefully selected and well-drained location, bearing in mind the fact that the base of the fire pit is one foot below the surface of the ground and that any possible entrance of moisture through percolation would seriously affect the drying of the copra. Surrounding the "bure" a drain should be dug such that, at all times, the water level in it should be at least twelve inches below the level of the floor of the fire pit.

Provided that the materials used in construction are poor conductors of heat and that the principles of construction are observed, any readily available materials may be utilised. Kilns have been satisfactorily constructed of rough sawn timber and of "bush" timber with equally good results and as "bush" timber is always easily available this type of kiln is recommended especially as its use reduces the cost of construction to less than 25s. exclusive of the costs of labour employed in erection of the kiln and the "bure."

For a "bush" timber kiln the only materials which normally require to be purchased are:—

| | | | |
|---|---|---|---|
| Nails (2 lb 4in, 7 lb 3in., 3 lb 2in.) .. .. .. | £0 | 4 | 0 |
| Hinges for door (1 pr. 6in.) .. .. .. .. | 0 | 1 | 0 |
| Wire netting ½in. mesh (6ft. by 6ft.) .. .. .. | 0 | 3 | 0 |
| Supporting rods (4 pieces angle iron 6ft. 4in.) .. .. | 0 | 5 | 0 |
| Baffle plate (2 sheets 6ft. by 3ft. wired together) .. | 0 | 10 | 0 |
| | £1 | 3 | 0 |

Of the above items the hinges can be dispensed with, and iron supporting rods can be substituted by old water piping or other iron bars or by bush timber polings, but iron is preferable. Protective tin sheets around the inside wall of the kiln can always be made of flattened biscuit boxes or kerosene tins, &c. "Niusawa" has been found to be very suitable for the walls of the kiln and any hard timber may be used for corner posts.

Should sawn timber be utilised for the kiln construction, approximately 350 super feet would be required. If imported rough oregon is used, this will cost about £4 10s. 0d. but if local "Kauvula" or similar timber is used the cost should not exceed £3 10s. 0d. and timber is best purchased in the following dimensions, if possible:—

| | | | |
|---|---|---|---|
| Corner posts .. .. .. | 4 | pieces (4in. by 2in.)—length | 6ft. 2in. |
| Bottom stays .. .. .. | 4 | ,, ,, | 8ft. |
| Top stays .. .. .. | 4 | ,, ,, | 6ft. |
| Door supports .. .. .. | 2 | ,, ,, | 6ft. |
| Copra chamber stays .. .. | 2 | ,, ,, | 5ft. |
| Planks—combustion chamber.. | 12 | (12in. by 1in.) length | 15ft. |
| Planks—copra chamber .. | 4 | (12in.) length | 6ft. |
| Planks—copra chamber .. | 2 | (6in.) length | 6ft. |

Diagramatic plans (diagram 1) of these small kilns can be had on application to the Department of Agriculture. In addition, when requested, materials will be supplied to small holders at cost price and every assistance will be given in the construction and routine operation of the kilns by trained Native Field Assistants.

The drying procedure is as follows:—

*First day.*—Husk 1,500—1,600 ripe nuts—one man can do this in 10–11 hours.

*Second day* (6 a.m.).—Split the nuts, discard bad ones or those with a germination core of more than 1½ inches in diameter. Drain the half nuts half an hour, meat side downwards on a clean porous surface ("vata").

(7 a.m.).—If dull or wet weather prevails, light at both ends, a single row shell fire of 160 half shells disposed as in diagram 2.

(8 a.m.).—Place the drained half nuts on the kiln and maintain the above fire continuously till early next morning by building a new "worm" of shells as the previous one burns out. First day requires about 350 half shells and the half nuts in the copra chamber should be turned about 2 p.m.

*Third day* (6 a.m.).—Turn over the half nuts in the copra chamber. Set and light a double row shell fire (see diagram 2) and maintain for 20 hours—this requires about 650 half shells. About noon the nuts in the copra chamber should be turned over.

*Fourth day* (6 a.m.).—Turn over the half nuts in the copra chamber, set and light at one end a single row shell fire and maintain it continuously until evening. This requires about 300 half shells. Turn over the nuts in the copra chamber about noon. In the evening or early next morning separate the copra from the shells and remove both from the copra chamber.

Should the morning of the second day (first day's drying) be hot and sunny, the drained half nuts should be turned so that the meat is exposed to sun and wind as long as the sun remains hot. By this means, smoke damage is reduced to a minimum since the surface of the meat is partially dried before the half nuts are transferred to the kiln by 5 p.m., not later, (sooner if sunny weather fails). Again, in this case, the fire in the kiln should be started an hour before the half nuts are placed in the copra chamber when the above programme of drying is continued in the kiln as from the same hour on the first drying day.

After the completion of drying, the copra should be piled loosely on a dry surface in part of the drying "bure" and turned over daily for several days before bagging.

Should a thermometer be available, the drying process can be regulated by adjusting the fires to maintain temperatures (in the middle of the copra) within the following ranges:—

| | |
|---|---|
| First day's drying .. .. .. | 45°—55°C. |
| Second day's drying .. .. | 55°—65°C. |
| Third day's drying .. .. | 45°—55°C. |

Overheating on the first day is liable to caseharden the copra, resulting in irregular drying, while underheating on the first day renders the copra liable to became mouldy. Cold spots in the kiln and inequalities in heating result in bacterial sliming giving a reddish brown product. This is best avoided by turning over the copra at least twice daily as indicated in the routine procedure.

After the second day's heating, much of the copra should fall out of the half shells and such self emptied half shells should be removed in turning over the copra before starting the third day's firing. The third day's firing should be continued until the copra is properly dry when it will break under pressure with a sharp snap and the fracture will reveal an even pearly surface. Should this not occur after the third drying day (due to wet weather) the single row shell fire must be continued into the fourth day. In filling the copra into sacks, it should be heavily rammed down with a heavy (and dry) beam of timber to ensure not more than 15 bags to the ton weight of copra (it can be reduced below this number).

Some twenty of these kilns have already been erected by Fijians who are realising that they can themselves produce good copra in place of selling their wet or partially dried meat to Chinese storekeepers at depressed prices. In addition, there are inquiries and requests from all copra producing areas for Native Field Assistants to go and supervise the erection of many more kilns so that it is fairly safe to state that this type of kiln has come to stay and that it will prove a big factor in effecting an improvement in the quality of Fiji copra.

Arrangement of half shells for 1st day's firing

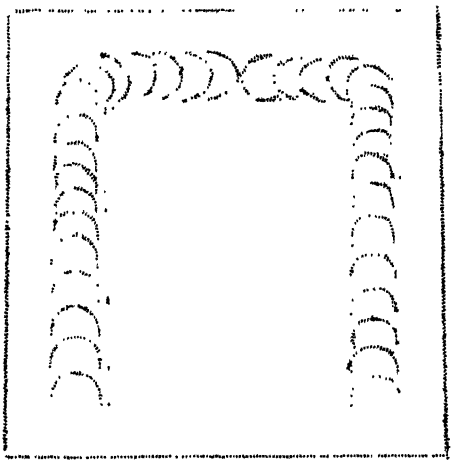

Diagram II.

Arrangement of half shells for 2nd day's firing

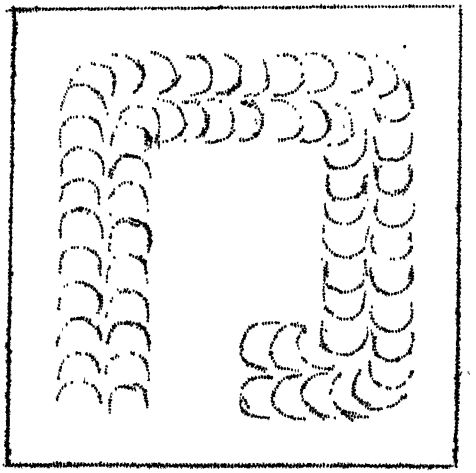

Diagram III.

By

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THIS article is intended to portray the present state of the tobacco crop in the light of observations made and information gained during a recent visit to Canada where every courtesy was shown to the writer.

The Canada tobacco growing industry has been long established, the first French settlers having learned the art from the Indians and the present importance of the crop is indicated by the estimated production for 1935 of fifty-five million pounds and by the maintenance of a special Dominion Tobacco Service conducting experimental and extensional work.

In Fiji the contrast is great. The crop is in the hands of Indians and Fijians who are so much out of touch with their markets that prices fluctuate violently from as low as 3d. per lb to as high as 6s. per lb. The Fijians still show evidence of the value of instruction received when tobacco was a "tax" crop, and some Indians possess a good practical knowledge, but the crop has been too long at the mercy of individual whim and ignorance.

Tobacco is one of the most sensitive reactors to all the varied factors that affect plant growth. For instance the "burn" alone is influenced by at least five variable factors; locality, climate, soil, season and cultural methods, while varietal differences play a very important part. In Quebec, it is stated that twenty-nine varieties are commonly grown and comprise six types according to method of curing and utilisation. Subsequent to growth, the leaf has yet to be subjected to the important processes of curing, fermentation and storing and want of uniformity in any one of these may involve an equal want of uniformity in the product.

In fact, it is not often sufficiently realised how numerous are the qualities demanded in a good tobacco.

Typical of the "points taken into consideration" are those mentioned in *Tobacco Station Bulletin* 10– New Haven, Connecticut, which states that "in judging the burn," the following points are taken into consideration:—

1. Fire holding capacity.
2. Colour of ash.
3. Closeness of burn.
4. Evenness of burn.
5. Flavour.
6. Aroma.
7. Coherence of Ash.

These points have particular reference to cigar tobacco, but they are typical of the variety and exacting nature of the requirements for a good quality product, and indicate the difficulties to be faced.

It is obvious that the selection of a variety of Tobacco and of a suitable locality is but the commencement of a series of problems to be solved before any specific type of tobacco can be produced.

In Fiji, certain localities have become known as producing superior quality tobacco, and a few more or less fixed varieties have been evolved save where European enterprise has caused the importation of new varieties with subsequent crossing.

In Quebec, the large range of varieties grown and marketed by name is a serious problem, and the Dominion Tobacco Service now distributes free seed of desirable pure varieties in an endeavour to obtain the uniformity that is so essential to modern market requirements.

Fiji has still the advantage of a paucity of varieties in general cultivation and it is undesirable that this number be added to needlessly. The decision rests with the consumer, and at present the local consumer is content with the local product.

The section that demands imported tobacco requires a product which is probably beyond the ability of either Fijians or Indians to supply at present since the curing of such tobacco is so much an art that on the American Continent experts are paid to undertake this special task after harvest.

Therefore in Fiji, for some years yet, the aim should be to discourage the introduction of new varieties save for definite and controlled experiments such as are already in progress by the Department of Agriculture. It is possible however, that the long acclimatised and locally appreciated native tobacco may provide a type suitable for our needs and with this end in view seed of the main local type has been sent to the Central Experimental Farm, Ottawa, for trial and the opinion of the Canadian tobacco experts will be of interest. In addition, selection experiments are envisaged locally.

Reference has been made already to the attention paid in Canada to the purity of tobacco seed and this important consideration is altogether neglected by native growers in Fiji. In *Bulletin* 38 published by the Canada Dominion Tobacco Service it is authoratively stated that " plump, heavy seed for the production of strong vigorous seedlings is really more important than in producing practically any other crop." Also it is practically impossible, in selecting plants at the bed, to discard all of the weak seedlings produced from small light seed, therefore selection should be effected by cleaning the seed before it is sown. Furthermore, the average germination percentage of ordinary seed is about fifty while well cleaned seed should give a germination percentage of about ninety; hence with cleaned seed a smaller bulk of seed is handled at the time of sowing, and as a rule, a uniform stand is more likely to result. The cleaning of tobacco seed in Canada is done with a very simple but efficient apparatus in which the seed is subjected to a blast of air sufficient to drive off trash and light seed.

There is much room for improvement in Fiji in the sowing of tobacco. A handful of dirty seed is thrown on a roughly prepared bed—often the former site of a "bure" that has been burnt down. The selection of a site sterilised by fire is sensible, and a sign that the growers should be reasonably receptive to teaching. Even allowing for the necessities of a vigorous climate the precautions taken in Canada to obtain robust seedlings are very thorough. One of the simplest of these precautions would effect a vast improvment in Fiji and this is the avoidance of over crowding in the nursery which is effected by the mixing of the seed with a suitable medium such as cornflour in the proportion of one of tobacco to fifty of cornflour. The mixture, sprinkled from a common salt shaker, provides an even distribution of seed as the flour is so conspicuous. In Fiji, the more readily available medium is wood ash. In mixing, the seed is best sprinkled on successive layers of ash, the whole then being mixed uniformly.

In general cultural practices, experience has taught the Fijian growers adequately so that contrasts are not obvious.

In harvesting however, the distinction between scientifically guided practice is again evident as well as the blind groping of primitive agriculturists. In Canada the enlightened grower is advised by experts who have evolved a precise practice for the production of leaf to suit the requirements of manufacturers. For instance, every step in the handling of leaf from harvesting to sale is planned and specially designed equipment is utilised. In experimental Stations the routine harvesting, curing, grading, fermenting,

and packing are studied critically resulting in improvements in detail. Thus, for whole plant harvesting knives or hatchets for cutting the stems are now replaced by long two-handed shears with which the harvesters work quickly, leaving the plants in neat rows with the butts all facing towards the sun. Another simple but beneficial improvement is the introduction of grading boxes into which the leaf is placed directly on stripping from the fermenting stack and in which baling is possible by a simple press.

Simplicity is studied so that much equipment may be made inexpensively on the farm.

The writer made a particular study of all methods employed in Canada, though it is premature to hope for such efficiency with the ordinary type of grower in Fiji. Unlike Canada where expert tobacco buyers can trace a defect back to some primary error, Fiji has for its tobacco market customers, who cannot define their requirements so that the experimentalist in this country is faced with the comprehensive task of first defining the desirable characteristics, and then of seeking them.

Amongst local advantages the thatched "bure" can be a most desirable curing shed and is superior to the average shed utilised by the inferior type of agriculturist in Canada, while the uniformity of an insular climate counteracts to a material extent, the lack of scientifically designed curing barns and the absence of specialists in the delicate art of curing and fermenting, so that at his best, the local tobacco grower can turn out a fairly good article.

Provided with reliable seed, and a steady market for a specified type of leaf the Fijians and Indians should find it possible and profitable to produce local tobacco of reasonably good quality.

The Department of Agriculture is already assisting with seed towards attaining this desirable objective, and is now undertaking to purchase dark leaf of good quality and from 15 inches to 18 inches in length in order to afford a steady market for growers who can also retail larger leaf at the more advantageous prices often obtaining, and utilise rejected leaf in making "uma" twist.

It is hoped that advantage will be taken of the assistance offered and that the local tobacco planting industry will expand considerably.

The numerous publications of the Dominion Tobacco Services, Canada have been freely used in compiling these notes and full use has been made of very instructive discussions with officers of that Service and with the staffs of the Imperial Tobacco Company and of Benson and Hedges (Canada), Ltd., Montreal.

The writer is highly appreciative of the consideration shown him during his brief visit to Canada.

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## COTTON BUYING AND GINNING.

By
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IN the buying and ginning of cotton there are many snags which have to be encountered and which can only be recognised by experience and by careful inspection at all stages of the work.

Fortunately in Fiji the buying and ginning of cotton is beset with few snags compared with many other cotton producing countries.

The reason for this satisfactory state of affairs is that the growers and sellers of the present day are not new hands at the business, and have had a strict training since the revival of the industry in 1923. The varieties now grown are two only—Sea Island and Back Cross 172—both being classed as extra-long-staple cottons. The other varieties found growing when the industry was revived in 1923 and the new varieties introduced surreptitiously in 1923–24–25 were all cleaned up on Viti Levu by the end of 1925. So that the greatest snag or snare, that of mixing of various cotton is almost out of the question in Fiji. Nevertheless, a constant vigilance is still necessary since a small portion of mixed lint may be drawn from a bale when sampling and this may wreck a good reputation not only as regards all the bales in a particular shipment which will be treated with suspicion and a corresponding cut in price, but all future shipments will have to live down a doubtful reputation as well.

### LOSS IN LINT.

Though every care may have been taken to test the lint yield or percentage early in the season, and though allowances may be made for the seasonal conditions, it is usually found that there is a distinct falling off in the percentage of lint. This in Fiji is invariably due to the weather, as damp or imperfectly dried out seed cotton or fraudulently watered material may become defective in lint percentage. One cannot be too careful over this snag and allowances have to be made to cover it. Damp seed cotton results not only in loss of weight, but in class, strength and ginning output, as well as producing poor seed. There is also the risk of spontaneous combustion. When "passing" the least suspicion of internal dampness should be checked critically by emptying the bag and if found intentional, the culprit should be heavily discounted in assessing the weight.

### DYE FROM BAG MARKS.

Some sellers and growers mark their bags with "Analine" dyes, crystals or powders, which have not been properly mixed, the result being that some of the dye stuff penetrates or works through the bag, and on to the seed cotton. This is serious, as the powders or small crystals cannot be detected at the time of passing or ginning and the defects may not show up until the yarn is being conditioned, or the fabric dyed. If there is the slightest doubt of the dye entering the seed cotton, then immediately the marks should be cut out of the bag, and a few handfuls of the seed cotton removed and thrown right away from all other seed cotton and the bag should likewise be destroyed. Ordinary washing blue is the best marking substance in Fiji. Anatto may be used, also properly mixed paints. Oils should not be used for making up marking paint as it is frequently found not mixed properly and large patches of damaged seed cotton are found in bags, due to the absorption of oil. The use of dyes and paints for marking bags should always be discouraged.

### FALSE PACKING.

This is not a common practice in Fiji. Those who were caught at it in early days were severely dealt with and it ceased after 1925. Occasionally stones with seed cotton at 2½d. and 3d. per pound, are still to be found, however, but the worst form of adulteration is the use of fine sand. Nowadays false packing is seldom seen but still it is necessary to have every bag emptied, turned inside out and picked clean of all adhering seed cotton. Bags that open up with a nice surface that has been fluffed out are always suspicious. To improve the appearance sellers may fluff, or open out the top layer of seed cotton. This naturally improves the class or appearance but should be carefully examined before being passed. Now that all seed cotton is being purchased as F.A.Q. standard and a lower grade, strict grading and classing is of less importance, but it is still necessay to examine every bag of seed cotton delivered since once a trick is found to be passable it will undoubtedly be repeated.

### " PIG-TAIL " COTTON.

Though this type of seed cotton is clean and free from all trash it is troublesome as in the process of the extra cleaning the fibres become twisted and 10 per cent. to 15 per cent. may have to be removed. This extra cleaning process is quite unnecessary and most of the growers know it. Also it prevents the lint from being ginned properly and reduces the ginning output. Hence this type of seed cotton should be discouraged firmly.

### DESPATCHING SAMPLES AND BOXING STANDARD TYPES.

To save loss in business, time and confusion samples should never be despatched without enclosing two separate labels, giving the description and marks. It is also advisable to inscribe such marks both on the outside and inside of the wrapping paper, or boxes.

### TIPS ON GINNING.

The ginning of cotton in Fiji is done with the simplest type of roller gin—the Macarthy Single Action, Single Roller Gin. This gin stands out on its own when ginning long stapled cotton, such as the Sea Island. The object in ginning is to remove the lint or hair from the seeds, with as little damage as possible, also to extract all dirt and foreign matter. Sea Island or extra long stapled cotton cannot be treated in Saw Gins, or passed through " openers " " extractors " or various kinds of cleaning machines as can short stapled cotton. The process of cleaning is by picking it by hand and whipping or throwing it against a wire netting frame, which opens or fluffs out the hairs on the seeds and removes foreign matter prior to ginning. Opening the seed cotton improves the outturn from the gin, but the " opened " fluff should not be rammed into the hoppers of the machine.

### OILING GINS.

In oiling, care should be taken that the gin boy is not too liberal with the oil, especially at loose pulleys, and end bearings. Oil guards should be properly fixed, otherwise there is the risk of the lint being splashed with oil. Only heavy oil, such as axle grease should be used. The end bearings of the roller accumulate cotton, which has to be removed now and then. This cotton must be put into a different bag and not thrown on to the cleaning cots. It should not be shipped out of the country, but used locally for stuffing cushions, &c.

### LOSS IN OUTTURN.

The loss in outturn varies with the class of seed cotton being ginned. The most frequent cause of poor outturn is due to sleepy labour, roller belt slipping, or to smooth rollers. The roller should be roughed at least twice a week, with a carpenter's crosscut hand saw without set. If set, and in unskilled hands, it rips the grooves in the rollers, thus causing the cotton to " nep " and also forms ragged spots, which on further roughings, become larger and eventually cause cut seeds or squeezed seeds to pass under the fixed knife. The effects of " forcing " the gin or speeding it up excessively may improve the outturn, but damages the lint, causes nep crimping, weakens the hairs, removes the sheen or bloom and straightens out the convolutions and in some cases changes the colour. The roller should never get so hot that it cannot be touched by the hand. Gin feeders have a habit of pushing the seed cotton on to the grid mouth with the palms of their hands. This rolls or creates a kind of " pig-tail " cotton, which knots and is liable to be cut in ginning. The feeding should be done by shaking the cotton, to open it and then by sprinkling or throwing it evenly along the grid. Overpacked grid spaces lead to roping or rolling of the seed cotton which damages the lint, and at the same time lowers the outturn. An experienced gin feeder will get 15 to 20 per cent. better return. Good dry seed cotton gives the best outturn, which improves with the increase of atmospheric humidity but the seed cotton must not be damped in Fiji.

### BROKEN FIXED AND MOVING KNIVES.

These are usually caused when ginning Sea Island, by back lashing cotton, or cotton clinging on to the roller instead of freeing itself at the " fall " with the result that it passes back under the fixed knife which is forced out and comes in contact with the moving knife. Wet seed cotton and lint should never be fed to the gin. It will break the knives.

The idiosyncrasies of ginning and gin setting are numerous. Makers' rules, gauges, &c., are of little use. Each cotton seems to have different needs, and it is only through practical experience, and experimentation that correct results are obtained. It is necessary to be on the spot, and in direct contact with it when the snags that drift along the path of the grader or ginner can be more easily explained. The personal element plays a large part both in the grading and in the ginning of cotton, in spite of all the recent scientific investigations. However, it is pleasing to note that much more attention is now being paid to the ginning of cotton, which has been sadly neglected, and it has been a mystery to many why the damage and waste in the cotton was never tackled from the commencement of its mechanical treatments.

# THE BIOLOGICAL CONTROL OF THE COCONUT LEAF-MINER (*Promecotheca reichei*, Baly) IN FIJI.

By

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## INTRODUCTION.

*Promecotheca reichei* is an indigenous insect in Fiji, and there can be little doubt that until about 50 years ago it was well controlled by indigenous natural enemies. The advent and development of trade, however, and the extensive cultivation of the coconut palm, resulted, indirectly, in this insect becoming a serious pest, particularly in the Lau Group. A very detailed study of the insect itself, and of its natural enemies in Fiji, was made in 1929; and this study served to reveal the factor which had been responsible for making a pest of this previously well controlled insect, and suggested, at the same time, that an economically satisfactory equilibrium might be restored by the introduction of a suitable parasite from overseas. No suitable parasite was known at this time, but a preliminary investigation in Java in 1930, made by R. W. Paine, led to the discovery of a large number of parasites of an allied species of *Promecotheca* (*P. nuciferae*, Maulik), which occurs throughout Java, but is never a pest. Paine was unable to study these parasites in detail, being then primarily engaged in other work, but in 1932 they were thoroughly investigated and the opinion was formed that although most of them were incapable of satisfying the exacting conditions in Fiji, one of them was theoretically capable of doing so. This one was introduced into Fiji early in 1933, and within a year it had completely suppressed all the severe outbreaks of *P. reichei* which were then raging.

The writer hopes to publish a detailed technical account of this campaign at a later date, and the present paper is intended only as a general statement for those who are not interested in full entomological details and statistics.

## *P. reichei*—ITS HABITS AND THE NATURE OF THE DAMAGE DUE TO IT.

*P. reichei* is a day-flying beetle which lays its eggs upon the undersides of coconut leaflets. The eggs are laid singly, and each is covered with a capsule composed of semidigested particles of coconut leaf-tissue which are expelled as excrement by the female immediately after the act of oviposition. The larva lives wholly within the leaflet, forming an elongate mine which, when completed, is usually about 6 inches long and 0·4 inches wide. When fully grown the larva becomes a pupa within the mine, and in due course the adult beetle emerges from the pupa and from the mine, biting a characteristic hole, oval in outline, in the upper wall of the mine to effect its escape. The adult beetle feeds upon the leaves externally, making linear incisions in the lower epidermis and the parenchymatous tissue, without, however, penetrating the upper epidermis. The total life cycle, from oviposition to emergence from the mine, covers approximately three months, and a further period of two weeks elapses before oviposition commences. Each female then continues to oviposit for 2 weeks, laying about 20 eggs in all The small egg-capacity is particularly noteworthy.

In severe outbreaks the activities of the larvæ and adults together caused a reduction of about 75 per cent. in the functioning leaf surface of every

tree over wide areas. The population of this insect in any one tree was usually about 4,000 at the time when an outbreak was at its height, and no extensive spreading took place until this density of population was attained.

### THE NATURE OF OUTBREAKS.

Outbreaks developed very slowly on account of the long life cycle and the small egg-capacity of the insect. The pest was found to require 14 months to multiply from a condition of rarity to one of maximum abundance within the area initially occupied by it. To a casual observer the outbreaks appeared to develop very suddenly, but this, in fact, was never the case.

Almost all outbreaks of maximum severity displayed one remarkable feature; namely, that only one stage of the pest was present at any one time. That is to say, there was no extensive overlapping of generations. In a climate like that of Fiji, this was remarkable because the insect can breed continuously throughout the year and the variation in the rate of development, together with the two weeks duration of the oviposition period, is sufficient to cause all stages to be present simultaneously within three generations after the first eggs are laid in any locality. Yet, year after year, the lack of overlapping of generations was preserved; and the discovery of the cause of this condition, and the thorough appreciation of its significance, proved to be the key to the whole problem.

### THE NATURAL ENEMIES PRESENT IN FIJI PRIOR TO 1933.

The important natural enemies already present in Fiji were only three in number:—

1. *Oligosita utilis*, Kow. (Trichogrammatidæ).
2. *Elasmus hispidarum*, Ferr. (Elasmidæ).
3. *Pediculoides ventricosus*, Newp. (Tarsonemidæ).

Of these, the first two are indigenous, while the last was undoubtedly accidentally introduced—most probably in the cargoes of ships, where it feeds upon a variety of insect larvæ in stored products. The date of arrival of this mite in Fiji cannot now be determined, but it was probably about 50 years ago.

*Oligosita utilis* is an egg parasite, and several individuals develop in one egg of *P. reichei*. Its life cycle covers nearly two months. *Elasmus hispidarum* is an external parasite of the larva of *P. reichei*, with a life cycle of only two weeks. It is liable to be attacked by three parasitic insects (*Tetrastichus taylori*, Ferr., and two Eupelmids not yet named) and also by the mite *P. ventricosus*. The latter is an external parasite attacking a great variety of insects living in sheltered situations.

*O. utilis* and *E. hispidarum* are, with very little doubt, the parasites which formerly controlled *P. reichei* effectively throughout Fiji, and they still do so in most parts of the Colony other than Lau.

### THE CAUSE OF OUTBREAKS OF *P. reichei*.

The principal cause of the severe outbreaks of comparatively recent times proved to be the mite, *P. ventricosus*. The effect of the mite upon *P. reichei* and its indigenous parasites was exceedingly complicated, and it is impossible here to give a full account of it. The summary account which follows, however, covers all the more important aspects and applies to the great majority of outbreaks.

The mite attacked the larvæ (of all ages) and the pupæ of *P. reichei*. In the Lau Group it multiplied in dry weather with incredible rapidity, and in the dry season of each year it soon attained a degree of abundance sufficient to enable it to destroy all of the *P. reichei*, except adults and eggs, in any locality. This elimination of larvæ and pupæ was continued until eventually a condition was reached in which the only individuals of *P. reichei* remaining alive were a few adults. These, being active, were not liable to the attack of *P. ventricosus*, and consequently the mites had no food left and died in vast numbers of starvation. The beetles, now very rare, oviposited; and in due course their progeny also oviposited and so caused the species to be much more plentiful but to be present in a one-stage condition which was quite abnormal and which resulted from the earlier elimination of all stages except adults at the same time. Wet weather very greatly hindered the mite, and during the wet season, therefore, *P. reichei* tended to regain its normal condition of complete overlapping of generations. Before this condition was attained, however, another dry season set in, and the one-stage condition was completely restored by the mite. The effect upon the indigenous parasites was, briefly, that they were rendered absolutely incapable of exercising their normal degree of control by the absence, for long periods at regular intervals, of the stages which they required for food. They were unable to multiply continuously, and they were unable to survive, except in very small numbers, from one generation of *P. reichei* to the next. During the wet season of every year therefore, the pest multiplied without any appreciable check; and if, at the time when the weather once more become favourable for the mite, the predominant stage of *P. reichei* was the adult stage, so that the mite could not at once take advantage of the favourable weather, then *P. reichei* attained a degree of abundance sufficient to cause great damage.

In this way, in general, *P. ventricosus* caused *P. reichei*, a normally rare insect, to become a serious pest in the presence of the very parasites which normally controlled it. Had the mite not received a severe check from wet weather every year it would itself have replaced the indigenous parasites very satisfactorily, but the sudden cessation of its activities every year due to wet weather, had precisely the reverse result.

In the wetter parts of Fiji *P. reichei* was seldom a serious pest because the distribution of rainfall throughout the year was such that *P. ventricosus* was seldom provided with the very dry conditions which it required for rapid multiplication.

### THE SELECTION OF A PARASITE FOR THE CONTROL OF *P. reichei*.

As soon as the significance of the activities of the mite was appreciated, it became evident that the conditions which any parasite would be required to fulfil if it were to control *P. reichei* were peculiarly exacting. It was evident, not only that the parasite would need to be able to multiply much more rapidly, relative to the pest, than the indigenous parasites, but also that it would need to be able to survive, without numerical loss, the long periods when no individuals of the pest were in a suitable stage for its attack. One of the many parasites of *P. nuciferæ* in Java satisfied these conditions, mainly because it attacked all the larval stages, and also the pupal stage, of its host. A parasite attacking many stages would obviously be able to find suitable hosts, in one-stage outbreaks, over a much longer period in each pest generation than one which attacked only one stage. Moreover, the period during which it would be unable to find suitable hosts would be

correspondingly shorter. The parasite selected in Java was *Pleurotropis parvulus*, Ferr. (Eulophidæ). This species is one of the least important of the many which together constitute an effective control for *P. nuciferæ* in Java, but there was every reason for believing that its status would be very different in Fiji conditions.

### THE HABITS OF *Pleurotropis parvulus*, FERR.

*P. parvulus* is an internal primary parasite of larvæ (of all ages) and pupæ of *Promecotheca* spp. It is a minute but very sturdy insect, and many individuals mature in each host individual The whole of its development takes place inside the host body, the adult parasites emerging from the empty skin of the host, inside the mine, and then escaping from the mine by biting minute, circular holes in its upper wall. The life cycle (oviposition to emergence) covers about three weeks, the egg-capacity is 80, the ratio of males to females is 1 : 4, and the adult life covers 5½ weeks. The female oviposits through the upper wall of the mine and directly into the contained larva or pupa.

### RESULTS OF THE INTRODUCTION OF *P. parvulus* INTO FIJI.

*P. parvulus* was eminently successful as a control for *P. reichei* within a year from the time of its first arrival in Fiji (May, 1933). It completely suppressed all the severe outbreaks then in progress on Vanua Balavu, Kanacea, Mango, Lakemba, and elsewhere. It attained 100 per cent. parasitism, literally, in all trees, even though in many outbreaks every tree, over hundreds of acres of land, contained about 4,000 *Promecotheca* individuals. A careful estimate showed that when the parasite population was at its maximum about 5,000 adult parasites were emerging in every tree every day, and that emergence continued at this rate for 10 days. In many outbreak areas not one *Promecotheca* individual escaped, even in isolated trees surrounded by forest. Moreover, the spreading capacity of the parasite proved to be as remarkable as its capacity for multiplication. The exceptional thoroughness of the work of this parasite was mainly attributable to the fact that many individuals matured in each host individual, so that the parasite population could suddenly exceed the pest population so very greatly that at least one parasite found even the most hidden or isolated mine. In short, *P. parvulus* showed itself to be capable of coping with the very exacting conditions which were due to *P. ventricosus*, and of succeeding in the circumstances in which the formerly efficient indigenous parasites had failed.

### THE PERMANENCE OF THE CONTROL EXERCISED BY *P. Parvulus*.

The extreme thoroughness of *P. parvulus* had one disadvantage. On small islets, or on small coconut areas isolated by sea or forest, the pest appeared to be completely exterminated. The parasite consequently died out soon afterwards, and then, if *Promecotheca* was accidentally introduced at a later date from another area or island in which control had not been effected at precisely the same time, outbreaks were again liable to occur as before, there being no parasites of any kind to check them.

This, fortunately, appeared never to occur on large coconut estates because the pest was not suppressed at precisely the same time in all areas. A constant interchange of pest and parasite individuals took place between

the different areas, until eventually an equilibrium was established. The equilibrium was such that *P. reichei* was rare and negligible, but still present in sufficient numbers to enable the now rare parasite to survive and prevent its host from multiplying extensively.

In most islands of Fiji, other than the Lau Group, *P. parvulus* has an alternative host in the form of *Promecotheca bicolor*, Maulik, a close ally of *P. reichei* which mines in the leaves of *Flagellaria* species. In the Lau Group, the parasite has no alternative hosts, but a species of *Flagellaria* is present on all the larger Lau islands and would serve as a permanent food supply for *P. bicolor*. The writer has been informed that an outbreak of *P. reichei* has recently occurred at Nabavatu in spite of, or perhaps because of, the extremely thorough suppression of the pest which followed the introduction of the parasite in 1933. Nabavatu is typical of the isolated areas already mentioned, and it seems most probable that the parasite defeated its own ends in 1933–34 by wiping out its host and so causing its own extermination. It is likely that the introduction of *P. bicolor* into the forests around Nabavatu Estate would overcome this difficulty by providing, for *P. parvulus*, an alternative host which could never be completely exterminated because it would be present and sparsely distributed over a very wide area. It is probable, however, that reintroduction of the parasite into Nabavatu from another part of Vanua Balavu would result in permanent control, provided the parasite were liberated at a time when the outbreak were still in its early stages. An existing outbreak, if already far advanced, could first be suppressed by reintroducing the parasite from elsewhere, and this introduction could be followed nine months later by another which would serve to check any further outbreak which might be developing. Total parasitism is possible only when the host is abundant, and if it can be arranged that the parasite is introduced at a time when its host is uncommon it is probable that both will survive and that a satisfactory equilibrium will be maintained.

There is every reason to believe that in all large areas the control brought about by *P. parvulus* will be permanent and that no further introductions will be necessary. In smaller, isolated, areas, on the other hand, outbreaks are evidently still liable to occur, and in such cases the right procedure will be, first to introduce the parasite again before an outbreak becomes severe; and then, if this should not give permanently satisfactory results, to introduce *P. bicolor* together with the parasite, the former being liberated on its food-plant in the forest and the latter some distance away in a coconut area.

## THE DETECTION OF ADDED WATER IN MILK.

By

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THE analysis of a sample of milk for the determination of fats proteins lactose and mineral constituents is not a difficult process where the normal facilities of a chemical laboratory are available. Normal chemical methods, however, fail to decide directly between a normal and an abnormal milk. This abnormality may be due to peculiarities in the beast producing the milk or to the direct addition of water for the purpose of increasing bulk.

It is to be remembered in this latter case that normal milk contains approximately 87·0 per cent. of water and therefore in order to detect the addition of water, the methods used must be capable of determining water not normal to the milk.

Richmond and Veith as a result of the analysis of many thousands of milk samples came to the conclusion that normal cow's milk had approximately the following values for its constituents:—

| | | |
|---|---|---|
| Fat .. .. .. | 3·7 | per cent. |
| Sugars .. .. | 4·7 | ,, |
| Proteins .. .. | 3·4 | ,, |
| Ash .. .. .. | 0·75 | ,, |
| Water .. .. | 87·30 | ,, |

If the figures indicated above are grouped into fat and solids not fat it is found that normal milk should have values of 3·7 per cent. fat and solids-not-fat of 8·85 per cent.

Similar researches carried out in New Zealand, Australia, Canada and on the Continent substantially confirmed these figures.

Legislation was therefore introduced in the various countries to define what was considered to be normal milk and the standard usually adopted states that normal milk shall be the milk taken completely from a healthy beast and shall have a fat content of 3·2 per cent. fat and 8·5 per cent. solids not fat. This standard is in operation in Fiji at the moment although evidence has been accumulated to show that the fat figure is normally much in excess of this minimum requirement, but that the solids-not-fat are frequently much lower.

The practice has been therefore to consider that all milks which do not come up to this standard are adulterated unless the contrary is proved. This assumption may cause undue hardship since there are many cases on record of genuine milk being below the standard demanded. This can be attributed either to breed of cattle, milking practice, poor feed, small herds, &c. In some countries, such as New Zealand, the milk from such cattle is directed to a butter or cheese factory and not offered for sale. Again, a magistrate would naturally take a different view of the case if the sample is intrinsically poor and not intentionally diluted but where he has only a standard to guide him in making a decision he is in the position of not being able to discriminate between a dairyman who intentionally waters his milk and the unhappy producer of normal yet poor milk. Again it is not generally recognised that the standards laid down are considered to be minimum standards and there are many herds that produce milk of a better quality. A dairyman may therefore dilute a good quality milk

down to the minimum standard and although committing an offence by adulteration so that his milk is not now normal as defined he is able to escape penalty because he has supplied a milk conforming with the standard. Water may thus be added up to seven per cent. without detection.

Apart from lowering the food value of a sample and defrauding the public, adulteration must always be considered a serious matter in the tropics since one cannot depend upon the bacterial purity of the water used for adulteration.

Within recent years the hands of the Analyst have been considerably strengthened by the adoption of two physical methods and one chemical method for the detection of added water and it is proposed briefly to discuss the merits of these mthods and their reliability.

(1) *The chemical detection of nitrate.*—Normal milk does not contain nitrate nitrogen unless such has been added as a preservative. Nitrates occur in most drinking waters and can be detected in very small quantities by means of a colourimetric method using an organic chemical reagent known as diphenylamine. It has been shown that nitrates taken by mouth are execreted in the urine and do not appear in the milk. The addition of nitrate to a milk for preservative purposes would be extremely rare and therefore the detection of nitrates in a milk supply would be strong evidence for suspecting the addition of water and when it can be shown that nitrate had not been added as a preservative the evidence is conclusive. This method fails when nitrates do not occur in the water supply. This is exceptional for most water supplies which usually contain nitrate nitrogen of the order of 0·01 parts per 100,000. In Fiji, however, our nitrate nitrogen is usually much lower than ·001 parts per 100,000 and in many cases it is impossible to detect the nitrate ion. This method therefore though valuable in England " when nitrates approach 0·5 parts per 100,000 " cannot be used satisfactorily in Fiji.

(2) *Refraction of the milk serum.*—This method is carried out by determining the refractive index of the milk serum suitably prepared, by an instrument known as the Zeiss immersion refractometer. Elsdon (*Analyst* 1927, p. 193) has shown that (1) milk with normal solids not fat gives a scale reading of 38 to 39 degrees, (2) that the addition of water reduces this figure by approximately two scale divisions for every 10 per cent. of added water and (3) the development of acidity increases the refraction by 0·2 degrees for every increase of ten degrees of acidity. He was not able to state whether the degree of acidity resultant on souring makes the reading unreliable. This method cannot differentiate between a milk that has been watered and one naturally poor in solids not fat and therefore appears to be less reliable than the solids not fat figures as an indication of watering.

(3) *The freezing point of milk.*—The osmotic pressure of milk is dependent upon the osmotic pressure of the blood of the animal supplying it. The osmotic pressure of blood is subject to very slight variation and may be considered under normal circumstances to be constant. Similarly the osmotic pressure of milk will be constant. The freezing point is a direct measure of the osmotic pressure and therefore for normal milk the freezing point may be considered to have a constant value or at least be subject to little variation. The osmotic pressure is determined by the soluble materials such as lactose and mineral salts present in true solution. The insolubale solids such as fat and protein do not effect the osmotic pressure. If there is a decrease in one soluble constituent the metabolic processes of the animal balance this by an increase in another soluble constituent and thus maintain a definite osmotic pressure. Thus a deficiency in lactose would be counterbalanced by an increase in mineral salts.

It is thus appreciated that the osmotic pressure as determined by the freezing point is a direct measure of the soluble solids.

It is known that the presence of soluble solids depresses the freezing point of a solvent. In the case of milk the solvent is water which freezes at 0 degrees Centigrade and the soluble solids are lactose, mineral salts and lactic acid if souring has commenced. If the milk is fresh the soluble solids depress the freezing point of the water and in normal milk this depression amounts to about —0·546 degrees C. with an extreme range of variation between —0·53 degrees to —0·56 degrees. If water is added to a milk there is consequently a smaller percentage of soluble solids contained in the same volume and hence the freezing point depression will be less. As water is added so the freezing point will approach nearer and nearer to that of the pure solvent that is 0 degrees C.

Several types of apparatus are used for this determination, *e.g.*, (1) Hortvet cryoscope as adopted by the Association of Official Agricultural Chemists in America and by the Society of Public Analysts in England. This is described by Elsdon and Stubbs (*Analyst*, 1930, p. 423). (2) Andrew's Apparatus (*Analyst*, 1929, p. 210), which is official in New Zealand and (3) Monier Williams Cryoscope (*Analyst*, 1933, p. 284) by means of which fundamental investigation were made in regard to the necessary corrections to be adopted to determine the true freezing point.

The apparatus best adapted for routine control is undoubtedly the Hortvet and this type of apparatus has been adopted for Fiji conditions. The apparatus has been described elsewhere and experience has confirmed its reliability and shown that the most important points to be considered are: (1) rate of stirring; (2) super-cooling; (3) rate of cooling and above all (4) the accuracy of the thermometer.

In regard to the first three factors the technique of the A.O.A.C. as modified by J. R. Stubbs has been adopted as a result of a series of comprehensive investigations which he has carried out (*Analyst*, 1935). The thermometers in use by the Department are standardised by the National Physical Laboratory over the requisite range and are further corrected in accordance with the A.O.A.C. method.

Many tens of thousands of freezing point determinations of milk have confirmed the value of the method and also the opinion that, of all the variants in fresh milk, the freezing point is the one which most nearly approaches constancy.

It is possible to read the thermometer with an accuracy of 0·002 degrees centigrade and since the addition of 1 per cent. of water reduces the depression by ·005 degrees it is thus possible to detect the addition of very small quantities of water.

The value of the test lies not only in its ability to distinguish good from poor milk but also to distinguish poor quality from watered milks. As has been pointed out above, the osmotic pressure of a normal milk is fixed and any changes which occur during metabolism do not markedly alter the sum total of the effects that give rise to constant osmotic pressure, although there will be relative quantitive differences in the milk components affecting the osmotic pressure. It has also been stated that abnormal milk has a greater depression than that accepted for normal milk and hence such abnormalities could not effect the value of the test in the detection of added water.

In conclusion it may be stated that the Analyst has secured in the Hortvert cryoscope a valuable weapon in the service of milk analysis and the general adoption of the process will do much to prevent the pernicious habit of debiting milk which has been found to be only too common in Fiji.

## THE FEEDING OF WORKING HORSES

By
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WHILE the principles of feeding are the same with all animals this note dealing especially with the horse may prove of local interest since there are some 12,000 horses in this Colony.

It is a recognised axiom in feeding that the animal body makes the best use of any food if the different food constituents are in correct proportion to each other; while if the proportions are incorrect some portion of the food is wasted or may even produce harmful results. It should also be remembered that the stabled horse has no power of selection but has to eat what he is given or go without.

Different foods contain the required constituents in different amount, some being rich in one and poor in another, other foods containing them in the correct proportions. Food constituents are divided into two classes—organic and inorganic.

The organic materials are all those constituents of the food excepting water and mineral solids. The latter constitute the inorganic portion. The organic constituents are, firstly, those contining nitrogen, known as proteids or protein containing foods. Chemically they contain the elements carbon, hydrogen, oxygen, sulphur, nitrogen and sometimes phosphorus. The horse derives most of his protein requirements from the order of plants known as legumes and from various concentrate foods such as maize, oats, cotton seed meal, coconut meal, &c.

The second of the organic constituents consists of oils and fats. These have a chemical basis of carbon oxygen and hydrogen, and their functions are to repair and renew fatty tissues while they also yield heat and energy. If given in excess they are stored up for future use especially in the form of fat, throughout the greater portion of the body. The excess of fatty food does not normally produce anything worse than soft condition which means the inability to do immediate hard work.

The third of the organic food constituents is the carbo-hydrate group represented by starches and sugars. These have the same chemical elements as fats, namely carbon, oxygen and hydrogen, but in this case the oxygen and hydrogen are always in the proportion to form water. The carbo-hydrates constitute the bulk of nearly all natural food and their functions are to supply heat and energy. They cannot be converted into proteids but they can be converted in the body into fats, indeed, it is probable that most of the body fat is derived from the carbo-hydrates. Like the fats they are completely oxidised in the body and leave the body in the form of carbon-dioxide and water.

The fourth organic food constituent consists of crude fibre, which is composed chiefly of cellulose which forms the framework of plants. Fibre is true carbo-hydrate but is classed separately because it is regarded as having no nutritive value since the digestion or solution of cellulose requires all the energy derived from it in the process of digestion.

The organic portion of the food consists of the mineral salts of which perhaps common salt (*sodium chloride*) is the most important to the adult animal. These salts assist in keeping the blood in correct order and form the source of hydrochloric acid in the gastric juice which materially aids the digestion. The complete withholding of common salt from food would cause the death of the animal from starvation owing to the proteid matter not being digested. Common salt usually does not exist in sufficient quantity

in the natural foods (grasses) for hardworking horses. If these animals are stabled, an addition should be made to their food of common salt, either in the mash or in the form of rock salt in the manger. In the vicinity of Suva, however, this is not so important, since the horses will always avail themselves of the opportunity of getting sufficient salt from the sea if their bodies feel the need of it. Phosphates, calcium, potassium, sodium, magnesium and iron salts are all essential to the repair and growth of different parts of the body. Phosphates of lime, potash, and magnesium go to the formation of bone and nervous tissue. Muscle tissue is rich in potash and iron helps to form the hæmoglobin or the red colouring matter of the blood.

The last food constituent is water and when it is remembered that almost two-thirds of the body is composed of water there is no difficulty in comprehending its necessity as a food. Its uses in the food are for the solution and conveyance of the food to the different parts of the system, the excretion of effete products, the regulation of heat by evaporation both from the lungs and the skin, and the regulation of all chemical and mechanical functions of the body.

A balanced food must therefore consist of proteids, fats, carbo-hydrates, salts and water. No two cereals contain these constituents in the same amounts or proportion. Thus, peas and beans contain a high percentage of proteids, linseed contains a high percentage of fat, while maize contains a high percentage of soluble carbo-hydrate, and none of these is in itself a balanced ration. One has next to consider the nutritive ratio or the proportion in which the food constituents are arranged towards each other, and what are the best ratios or proportions of the proteids, carbo-hydrates, fats and cellulose for a food to supply its highest economic value while at the same time maintaining the animal in perfect health. One should endeavour to get the best out of the horse by the cheapest method of feeding consistent with the good health.

## FODDERS AND FOODS AVAILABLE IN FIJI.

The range of local fodders is strictly limited. Available pastures in Suva district contain sensitive plant and a mixture of grasses. The sensitive plant is a legume and is therefore rich in protein. The mixed grasses contain chiefly carbo-hydrate and therefore, if there is sufficient bulk of good pasture in the paddock, a more or less balanced ration can be selected by the grazing horse. Other grasses are Para and Guinea grass. Where the available grazing area is limited the above mentioned grasses can be cut and fed to the horse either as cut or in the form of "chop-chop," which is simply the grass which has been put through a chaff cutter. Both Para and Guinea grass are rich in carbo-hydrate, and poor in protein and do not therefore constitute a balanced ration.

Available concentrates include coconut meal, which is cheap, rich in protein, fat and carbo-hydrate but has too close a nutritive ratio to be a balanced ration. Good quality rice bran which is practically free of husk, makes excellent food and has the same advantages as coconut meal.

Maize is generally available for the greater part of the year though prices vary considerably at present. It is better fed crushed than whole and is much relished by horses.

Molasses is a good feed consisting almost entirely of carbo-hydrate (sugar) but it is an awkward food to handle.

Available imported foods are oats, chaffed hay, bran and linseed but for working horses there is little need for these though oats provide an excellent concentrate food for getting race-horses into condition.

Imported wheaten and linseed bran may usefully be kept for medicinal puposes.

It has already been mentioned that the ration must be balanced, that is it must contain a proportion of protein to carbo-hydrate and fat in such a ratio that good digestion is obtained and the best advantage is gained from them. Natural pastures often do not form a balanced ration and with the exception of the "sensitive" plant, are poor in proteins. Concentrate should therefore be fed as an adjunct to grazing in order to maintain animals in the best condition to satisfy the eye and to perform their work. By supplementing the grazing ration or cut grass ration with mixtures of coconut meal, rice meal or maize, the above desired effect can be readily achieved.

The digestible nutrients of para grass, when compared with coconut meal and rice meal, are given for comparison:—

| | Total dry matter in 100 lb. | Digestible nutrients in 100 lb. | | | | Nutritive ratio. |
|---|---|---|---|---|---|---|
| | | Crude protein. | Carbo-hydrate. | Fat. | Total. | |
| Para grass .. .. | 27·2 | 0·8 | 14·0 | 0 3 | 15·5 | 1 : 18·4 |
| Coconut meal .. | 90·4 | 18·8 | 42·0 | 8·1 | 79·0 | 1 : 3·2 |
| Rice meal .. .. | 89·9 | 7·9 | 38·1 | 8·8 | 65·1 | 1 : 7·3 |

It will be seen that the Para grass has a very wide nutritive ratio and is therefore not a very complete food whilst the coconut meal has a very close ratio and is therefore too rich. Rice bran could not be used as a complete food owing to lack of sufficient crude fibre to form bulk. For a working horse the ideal is a nutritive ratio of about 1 : 7 and this is obtained by feeding a ration as follows:—

| | Total ration. | Dry matter. | Crude protein. | Carbo-hydrate. | Fat. |
|---|---|---|---|---|---|
| | lb | lb | lb | lb | lb |
| Para grass .. .. | 50 | 13·6 | 0·4 | 7·0 | 0·15 |
| Coconut meal .. | 6 | 5·4 | 1·128 | 2·52 | 0·486 |
| Rice bran .. .. | 3 | 2·7 | ·237 | 1·14 | 0·264 |
| Total ration .. | 59 | 21·7 | 1·765 | 10·66 | 0·9 |

This gives a total dry matter amounting to 21·7 lb per day which is a fair average ration for a working horse, and has a nutritive ratio as 1 : 7·2 which is quite reasonable.

The formula for the nutritive ratio is:—

$$\frac{\text{Carbo-hydrate} + (\text{fat} \times 2{\cdot}25)}{\text{Protein.}}$$

WATERING.

Horses should always be watered before being fed. A considerable amount of fluid is required for the production of gastric juice and watering before feeding helps this process. Watering after feeding not only dilutes the gastric juice and so weakens its action but also washes through the stomach a quantity of undigested food, the nutritive value of which is lost even if nothing worse in the form of bowel trouble occurs. There is some prejudice against giving horses water when they are sweating but this is an overrated prejudice. Such an objection might have foundation in a cold country but in Fiji water is never so cold that it will produce harmful effects. This abolishes the objection to watering whilst the animal is hot.

In nature the horse is a slow but more or less continuous feeder. Large bulky feeds with short time for feeding are therefore not indicated. One should bear in mind the axiom " little and often " and when working a horse allow him to feed as often as is possible.

It is hoped that this brief note may prove useful to horse owners in the Colony.

## KAU VULA (*Endospermum* sp.).

By
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Native Field Assistant.

THE Kau Vula is known as " Lekutu " in Namosi and as " Vulavula " in Vanua Levu. It is a rapid growing tree attaing a height up to 70 feet, according to the location.

According to Mr. R. A. Sykes' Report " they are widely distributed over the intermediate rain forest of Viti Levu, being particularly common in the forest of Serua, Namosi, Waindina and the lower part of Rewa." In general it appears to favour wet but not sour situations, and is found in the wet parts of the forest or confined to the lower parts of the slopes. The tree makes a nice shade by its large ovate leaves which are generally cordate at the base—the petiole is 2–4 inches long and the blade 4–9 inches long or even longer. The bark is smooth and brown with a yellow slash below, the fruits are divided into three cells forming one capsule with three seeds to each fruit. The timber is white, soft and light and makes an excellent timber for fruit packing-cases, but quickly becomes spotted with fungus in damp weather. It is also popular for firewood in native villages, as it burns well when it is dry.

Seedlings are obtainable from around the forests mentioned above and Fijians should be encouraged to plant up areas in the vicinity of their koros for the future supply of firewood and case timber.

In planting the holes should be dug two weeks before planting and filled in with available top soil. The holes should be spaced 10 feet apart, and the bigger the hole up to two feet the better. Planting should be done when the soil is thoroughly wet and an occasional weeding for the first two years is essential.

# HARVESTING, CURING AND FERMENTING TOBACCO.

By

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EXPERIMENTAL work on tobacco has recently been started at the Singatoka Agricultural Station and the following notes are furnished as a progress report to indicate the general methods employed in handling the tobacco crop. During the past season two methods were employed:—

(*a*) single leaf;
(*b*) whole plant.

The single leaf method consists of harvesting each leaf separately as it attains the correct stage of maturity. After wilting, the leaves are strung by piercing the mid rib of " tie " wire so that the leaves are back to back and blade to blade alternately. The wire when full is strung from end to end of the curing " bure " (native type thatch building 30 feet by 15 feet). The whole leaf method consists of cutting the main stem about three inches above the ground at the stage when the greatest number of leaves are at the optimum stage of maturity. This necessarily means that some of the lower leaves will be over mature while some of the top leaves will be under mature. The cut plants are allowed to wilt in the field before being conveyed to the curing " bure " and there are two methods by which the whole plants may be handled in the curing room. One is to attach a loop of twine (*Vau* is used at the Station.) to the thick end of the stem. The other method is to split the main stem from the tip towards the base to within three inches of the end. Sticks about ½ inch thick and 12 inches long are thrust into the thatch of the bure and the plants are hung from them, the sticks being placed so that each plant just touches its neighbours. Free circulation of air is essential but wind or strong draughts are avoided. Care in handling is required at all times and particularly when harvesting as the leaf is then turgid and brittle and any bruising will cause the finished product to appear much darker and probably " blotchy" by comparison with carefully handled leaves. It is advisable to harvest in fine weather only after a few fine sunny days and when the sun is well up and all dew has disappeared.

After the plants are harvested by either of the above methods they are allowed to wilt in the field. A temporary palm leaf structure is useful for wilting as the direct sun tends to cause sun scald. The object of the wilting process is partly to reduce the moisture content but chiefly to toughen the leaves for subsequent handlings. The time taken to wilt varies from, say, half hour on good drying days to perhaps two hours. The crop is then conveyed to the curing house, light wooden frames covered with sacking and built like an ambulance stretcher, being used for the purpose. Two men handle this stretcher with a minimum of bruising.

In the process of curing the plants are hung in the curing room as indicated above and the process of curing takes from four to six weeks, depending upon the variety of the weather conditions, and the method of harvesting, (the single leaf curing quicker and more evenly than the whole plant, there being less moisture to be eleminated). Early last season, while drought conditions prevailed, it was found that the leaf dried too quickly, even with the building closed all day and opened at night. It became necessary therefore, to increase and maintain the humidity within the curing house and this was achieved by periodically sprinkling water over the earthern

floor. This method appeared to suit local conditions satisfactorily. Later in the season after copious rains had fallen the problem was to reduce the humidity as some of the leaf was showing mould (particularly where whole-plant harvesting had been employed). This problem was solved by making small braziers (a one-gallon paint can is satisfactory) and burning charcoal fires in the curing house. Charcoal is probably the only suitable and easily obtained fuel for this purpose as it gives no smoke or odour which might be assimilated by the toabacco. Probably lines of clean dry coconut shells as used in small copra driers would also be satisfactory but these have not yet been tried at this station.

The curing process is carried on until the leaf is quite dry—a reliable index being the mid rib which should be quite tough and almost brittle—and the colour has changed over the whole leaf—to an even brown. Colour will vary greatly according to the variety, a light golden for some of the cigarette types, a dark brown for pipe and cigar filler types and a greenish brown for the best cigar wrapper types.

When the leaf is sufficiently cured it is taken down and prepared for the next process, opportunity being taken at this time to discard any badly damaged, improperly cured or mouldy leaves. Grading for size, colour, texture, &c., may also be conveniently done at this stage. In fermenting, the leaves are made up into " hands " of about 20 leaves and stacked into as large a heap as there is tobacco available—up to, say, 2,000 lb. This heap is covered with a tarpaulin or sacking and much attention must be given to it at this stage. It is necessary to see that the tobacco does not heat too much, 40° C. being a critical temperature. It is advisable to break down and restack the heap placing the upper " hands " at the bottom at each successive restacking. For the first week this should be done once daily, during the second week every other day, and for the following three weeks, once each three or four days. The leaf is then packed into sound wooden cases (zinc lined match cases are very suitable) covered with sacking and heavy weights are palced on top. About once each three weeks the leaf is turned out of the boxes and replaced, the position of top and bottom " hands " being reversed.

To make the best mellow tobacco it is advisable to continue this last stage for not less than one year, and preferably longer.

## ARECANUTS.

By

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Director of Agriculture.

FOR small holdings the arecanut would appear to be a potentially useful palm in Fiji and hence these notes derived from observations compiled by the writer during his sojourn in Malaya are recorded for future use.

The arecanut palm (*Areca catechu* L.) is said to have originated from wild species still found in the Philippine Islands (I) and is seen growing occasionally in gardens throughout Fiji and there is little doubt that it was introduced by Indian labourers for chewing purposes.

The palm grows best in rich well drained alluvial soils near the coast, but has also been seen inland at higher elevations.

The fruits of the palm are known commercially as " penang," " Areca " or " betel " nuts and they have a considerable economic value in India, to which large shipments are annually despatched from Java and Malaya. Malaya, for instance, over the last dozen years exported approximately 22,000 tons per annum of an annual value of some £700,000.

The hard mottled grey or brown nuts which are mainly used as a masticatory by natives of Eastern races are normally in steady demand in India.

Amongst the minor use of " betel " nuts, mentions may be made of its employment in the production of dyes and tanning material. The powdered nuts are also used as a dentifice, and as a verifuge in veterinary practice, for, as pointed out by Sands (2) the nuts are astringent and slightly acid to the taste and possess narcotic and anthelmintic properties due mainly to the alkaloid arecoline; though three other closely allied alkaloids have also been isolated from them. Other uses for the palm are as boundary fences, building materials, native house flooring, &c.

The main features of the palm are its tall, erect, slender unbranched, annulated stem, the compactness of its crown of dark green pinnate leaves, its pendulous bunches of ovoid green or orange (ripening) fruits and its tough fibrous radiating roots. Under favourable conditions, flowering commences when the palm is about five years old. The flowers have been described by Sands (2). Normally, self-pollination is precluded by the sequence of the male and female phases, but occasionally when growth is rapid, palms have been observed in which the male phase of the most recently opened spadix overlapped the female phase of the spadix immediately below, thus making self-pollination possible.

The fruit normally takes six to seven months to ripen when it becomes bright orange red in colour and about the size and shape of a hen's egg. The number of spadices produced per annum and the number of ripe fruits per spadix vary with the variety, with the general conditions of growth and with the age of the palm, but the better commercial types of medium age and under good conditions appear to produce three to four bunches per annum, each bunch carrying 100—250 fruits according to variety. Young palms will not produce so abundantly and though fair crops can be reaped at seven years after planting, the palms take 10—12 years to reach full production, and are reputed to bear remunerative crops under favourable conditions for over 25 years.

The germination of fresh seed commences about six weeks after sowing and continues for a further six weeks or so.

In the Far East the palms are grown chiefly in peasant homesteads in varying numbers from a few up to about 80 palms to the acre, interplanted with coconut palms and various fruit trees, with which they compete for available nutriment and light, or they may be found as boundary fences around the small holdings. Under these conditions the palms rarely get any cultivation save an occasional slashing of weeds and are usually grown merely for home consumption of nuts, but may become a minor financial asset in times of difficulty when the fruits can be sold or the palms rented to local dealers, usually Chinese, who purchase crops from small cultivators for the curing of nuts.

Where cultivation hardly exists, crops will naturally depend on soil and moisture conditions, and while good rich alluvial soil may result in a production of better crops the average production from mature palms is about 4 lb per palm or about 1,800 lb per acre per annum if an average stand is regarded as 450 palms per acre. Normally under fair conditions, crops of 1,100 lb should be derived after the seventh year and full production (1,800 lb) should be reached in the eleventh year after planting and is said to be maintained for over 20 years. Doubtless this period will be found to depend largely on growing conditions and should be influenced considerably by judicious cultural and manurial treatment. In Mysore, where climatic conditions are severe, arecanuts have long been established on a large area and the average crop is said to be about 2,000 lb though in the better areas crops up to 4,000 lb per acre have been attained and palms up to 40 years old are said to be remunerative (3).

### VARIETIES.

In Malaya the better known commercial types of which there are only about a dozen varieties, have already been described under their Malay names by Sands (2). They are mostly distinguishable by the size and shape of their fruits and of their kernels, the amount of colour in the endosperm and the taste. They include the Pinang kuning, jambu (or lemak), betul, rambai, telur, kerdu, seluang, kechil, gasing, malan, kelat and buntot tabuan of which the first eight mentioned are the most important.

In Fiji the only variety of common occurrence is similar to the "Kechil" type in Malaya, but recently a few of the other better Malayan types have been introduced.

### GRADING.

In Malaya, arecanuts are prepared for export in three forms (*a*) split, (*b*) whole (red and white) and (*c*) sliced. The quantity of each form exported varies from time to time according to demand which appears to be affected considerably by general economic conditions particularly in India and Burma, to which the bulk of exports are sent.

### "SPLITS."

The small dealers pay little attention to grading as long as their product is marketable, but in Singapore the big dealers take the following characteristics of the nuts into consideration in differentiating "splits" into three grades—1st, 2nd and 3rd quality:—

(*a*) size, the larger sixes being the better;
(*b*) the evenness of the cut, as jagged surfaces are wasteful in use and packing;
(*c*) the colour, which must be as uniform as possible;
(*d*) the "flower" which should be well defined and white;
(*e*) the dryness, on which the weight and keeping quality largely depend;
(*f*) the cleanliness, as affecting the general appearance of the product;
(*g*) the shape of the half nuts, which should be as nearly uniform as possible.

It is generally considered that the best quality "splits" can only be obtained if the fruits are picked when fully ripe and when the curing is gradual and uninterrupted. Usually, in preparing "splits" the fruits, split longitudinally, are kiln dried by large dealers (or sundried by the small dealers) for three days, before removing the husks with an instrument like a short screwdriver and for a further two or three days or more, after husking. The average price of "splits" in September, 1936, in Singapore was 18s. per cwt.

Large nuts can be more efficiently and profitably handled for "splits" than small nuts, hence varieties which produce fruits with large kernels should be grown to supply these popular grades. The adoption of "splits" as a marketable form for arecanuts would appear to be mainly a localised practice in Malaya and no doubt is due to local difficulty in drying whole nuts during uncertain weather.

"WHOLES."

Whole nuts are divided into two groups, white and red, according to the stage of maturity of fruit when harvested and to the treatment given in curing. "White wholes" consist of sundried nuts obtained from fully matured fruits, while "red wholes" are roasted nuts derived from fruits which have been picked when about 80 per cent. ripe. In each of these two groups, three grades are recognised, the grading being based on the following features in Malaya:—

(*a*) size of nut;
(*b*) dryness, as affecting weight, hardness and extent of curing;
(*c*) colour, which should be uniform (light brown for "whites," bright red for "reds");
(*d*) cleanliness, freedom from dust, fibres or foreign particles;
(*e*) "flower," white and well developed.
(*f*) shape; uniformity is desirable (very immature nuts shrink, become discoloured and rot at the core).

In these groups small nuts are desirable because they are more easily dried and are said to be of better flavour and keeping quality than large sizes. Also being sold by weight, consumers prefer a larger number of small nuts per given unit than a smaller number of larger nuts, because if a large nut is found to be defective when cut open the loss is proportionately greater than with a small nut. With small nuts less breakage is incurred in ramming them into sacks than with large nuts—an important factor, since the nuts must be unbroken and uniform in size to command the best prices.

Prices in September, 1936, in Singapore for "wholes" ranged from 9s. to 13s. per cwt. for "reds" and about 2s. per cwt. less for "whites."

The material differences in prices are said to be due to the fact that the "reds" being under ripe, contain much gum and are therefore better for dyeing purposes for which they are used in India. There is also a good market in Saigon for this class as Annam and Indo-China consumers prefer the gummy product for chewing. The "reds" when thoroughly dried, retain their quality in storage for a considerably longer period than "whites." Moreover, best quality "red" nuts are lighter than the same quality of "whites" so that equal weights of each quality will contain a materially larger number of "reds" than of "whites," which gives the "reds" a higher economic value. For medium qualities the difference in weights is distinctly smaller, while in third grade the "whites" tend to be less in weight than the "reds."

## "SLICED."

"Sliced" arecanuts are best produced from fruits which have been harvested when about 70 per cent. mature. As soon as possible after harvesting, the under-ripe fruits are husked, sliced traversely and roasted quickly and uninterruptedly; sun curing is too unreliable, as delay in curing causes distortion and discolouration of the final product. The grading of "sliced" nuts depends mainly on the following easily observable characters in the individual slices:—

(*a*) thinness; the thinner the better down to 1 mm.;
(*b*) flatness; curling should be avoided;
(*c*) colour (fairly dark red) and brightness;
(*d*) "flower," white and well developed;
(*e*) degree of dryness, as affecting keeping quality, weight and hardness;
(*f*) cleanliness, as affecting general appearance;
(*g*) slices should be entire and of uniform thickness.

Average prices for "slices" in September, 1936, in Singapore fluctuated around 21s. per cwt. for medium quality.

Slices are mainly prepared for export to Bangkok and the Coromandel coast of India. It is of interest to mention that a turnip cutter can be used for slicing as an aid to speeding up the curing process.

## CURING.

Small dealers, mostly Chinese shop keepers, supply the bulk of the local production of dried arecanuts for export, through large dealers at the main ports, who sometimes mix small consignments, re-dry and separate them into three grades.

Curing methods are crude, and as already mentioned, little attention is given to grading by the small dealers, who frequently pick their fruits under-ripe to reduce the chance of theft. In some cases, ripe and unripe fruits are separated and converted into different products, well ripened fruits being used for "white wholes" and "splits" while under-ripe fruits are converted into "red wholes" and "sliced," grades; but frequently no such differentiation is made, so that the average product received from small dealers is poor.

The usual method of curing adopted by the small dealers is that of air or sun drying for "wholes" and "splits" and of artificial heating for "slices," though the best quality "splits" and "red wholes" are also often kiln dried.

In the preparation of first quality arecanut "slices" instead of kilns, sometimes a series of large shallow iron pans is used, the whole "factory" being covered by a large palm thatched roof.

In the "factory" one labourer can attend to the stoking of all the fires, which are made of charcoal, requiring little attention and giving no smoke; to the transfer of drying "slices" from one pan to another at intervals of five to ten minutes in order to turn over, mix and prevent "slices" from burning, and to the porterage of the nuts in all stages of preparation.

Women usually husk the under-ripe nuts and slice them deftly with well sharpened knives, each nut giving 15 to 25 fine slices according to size.

Commonly, small dealers use a thin sheet of iron some four feet square supported on a brick wall five to six bricks high, as a kiln for drying slices. The sheet iron is perforated by many holes about a quarter of an inch in diameter, spaced one to two inches apart, and coconut shells are used for

heating. The slices, cut after husking partially dried nuts, are placed on the heated iron sheet for 30—50 minutes, and kept stirred to prevent burning after which they are deemed to be dry. The small dealers fully realise the difference between a well-cured and a badly-cured product, but take little trouble except in the preparation of " slices," and even these are often over heated and burnt, while " splits " and " wholes " are frequently dulled by interrupted drying often resulting from exposure to rain. In Fiji the retail prices in Indian stores are reported to fluctuate around 1s. per lb for " slices."

## GENERAL.

Arecanut palm seedlings are usually amongst the first plants to be estab lished in new holdings in Malaya after the jungle has been roughly cleared so that they enjoy very good soil conditions which promote quick and vigorous growth.

Once the palms are well established their cost of upkeep is negligible, since, as has already been stated, cultivation is not generally practised in arecanut groves.

In Fiji, the crop matures mainly between September and November and there is usually a steamer sailing directly for Calcutta in November–December so that this crop if developed on a sufficient scale could be utilised to supply cargo to the direct Indian steamer and to bring in remunerative returns for much land now idle.

Judging by observations, there is little doubt that locally grown palms would produce crops well up to those derived from haphazard methods in Malaya, hence in areas where easy transport facilities exist profits varying from 2s. to 5s. per cwt. according to type and quality of product and the market demand in India should be realisable.

In addition, there is a small local demand for nut for chewing since approximately one ton of nuts is imported monthly worth about £250 per annum for this purpose and there is little doubt that this demand would increase if local supplies were augmented. Furthermore the general utility of the palms for fencing and domestic purposes should prove an asset to the small holder.

Efforts are being made to establish large numbers of these palms in suitable areas but progress must be slow owing to many other communal calls on the time of the peasant and to the general lack of any immediate urge to augment his labours.

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## CANDLENUT OIL.

By

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ALEURITES Moluccana is a tree widely distributed throughout the Malay Archipelago and Polynesia and is known in Fiji as "lauthi" or "tuitui."

The seed of this tree contains a drying oil and from the kernels there is obtained on extraction with a suitable solvent 58 per cent. to 60 per cent. of a light yellow coloured oil. The cold expressed oil after filtration is almost colourless, but extraction with hot petroleum ether gives a brown coloured oil with an unpleasant odour.

According to Wright (*Oils Fats and Waxes*, 3rd Edition, 1921) the oil contains the glycerides of oleic, linolic, stearic, palmitic and myristic acids and, from its marked drying properties, linolenic acid is probably present. This has been confirmed by Philippine workers for similar oil from a related species ( (*Aleurites triloba*).

The oil readily becomes rancid and develops large amounts of free fatty acid. Samples recently examined in the laboratory gave acid values of over 40·0. When candlenut oil is boiled it produces a varnish which dries with even greater rapidity than boiled linseed oil. The soap produced from this oil resembles that obtained from coconut oil.

The value of a drying oil for paint or linoleum manufacture depends upon a property known as thickening when exposed to air oxidation. The oil dries and when spread out in a thin layer the oil hardens and forms a solid elastic film. Linseed oil and tung oils (*Aleurites Fordii* and *A. montana*) possess this property in a marked degree, making them valuable vehicles for pigments in the paint industry.

Aleurites moluccana also possesses drying properties somewhat similar to linseed, nevertheless from information obtained by the Department of Agriculture from interested firms in Australia it is considered to be somewhat inferior to linseed and would be of interest to firms concerned if it were marketed at a price somewhat lower than that offered for the latter oil. In other words the trade view the oil as a substitute for linseed and no doubt at a cheaper figure it would be mixed with the higher priced linseed.

According to Wright (*Agric. Circular Dept. of Agric.*, Fiji, 1921) the oil from "lauthi" nuts was used as an illuminant in Fiji before the advent of Europeans and according to the *Bulletin* of the Imperial Institute (1919, 17. p. 591) the export of candlenut oil was an important industry in the Philippines. Recent information from the Imperial Institute, however, indicates that there is little if any demand in England and America for the oil. This is no doubt due to the comparatively low price of linseed, the superior drying quality of tung oil, and irregularity of supplies of candlenut.

It is interesting to note that according to John Horne (*A Year in Fiji*, London, 1881, p. 190) small consignments of candlenuts were exported from Fiji. He states that exports were as follows:—

| | | | | | |
|---|---|---|---|---|---|
| 1875 | value of export | .. | £65 | 0 | 0 |
| 1876 | ,, | .. | £1,562 | 9 | 0 |
| 1877 | ,, | .. | £3,040 | 0 | 0 |
| 1878 | ,, | .. | £3,545 | 0 | 0 |

In 1877 the price paid on the beach for candlenuts was £10 per ton. Prices for linseed oil for the periods quoted above are not available, but no doubt were well over £45 per ton. The present (November, 1936) price for linseed oil in London is in the neighbourhood of £27 per ton.

It was stated by the Imperial Institute (*Bull.* 18, p. 25, 1920) that nuts sent from the Cook Islands consisted of 68 per cent. shell and 32 per cent. of kernel containing 4·5 per cent. moisture and 63·7 per cent. of a pale yellow oil with an iodine value of 158·5. It was further stated that the untreated oil dried very slowly but gave better results in this respect on heating. The oil was valued at £40 to £44 per ton with linseed at £54. With linseed at £27 per ton therefore, candlenut oil would be expected to realise about £22 per ton.

The manufacture of " kuikui " oil, as it is called in Hawaii from the kernels of Aleurites moluccana was once an important industry in that country and as much as 10,000 gallons was exported annually to the United States of America. Tung oil has practically taken the place of " kuikui " in that country and although tung oil is much more costly it has better drying properties and is much in demand by the paint trade. There is, however, a big demand for linseed and since candlenut oil is very similar in its properties to linseed and according to American opinion dries four hours sooner than linseed oil and can replace linseed for all purposes for which the latter oil is used it would seem, since this oil has disappeared from the world's markets, that either production costs must be high or else supplies were irregular. It is stated by E. V. Wilcox (*Press Bull.* No. 39, 1913, Hawaii, Agric. Exp. Station) that " kuikui " oil had been on the American market for 75 years and was used in making soap, paint, varnish and artists' oil.

Experiments which have recently been carried out in the chemical laboratory (see Table I) indicate that on the average the percentage of kernel to nut amounts to about 33 per cent. The oil content of the kernels is in the neighbourhood of 60 per cent. so that approximately one third of the nut is kernel and one fifth oil. From these considerations three tons of nuts would produce one ton of kernels and five tons of nuts one ton of oil. Assuming that oil is worth £22 per ton with linseed at £27 per ton, and that £7 per ton of oil will cover the costs of decortication, crushing, oil extraction, and freight, it is apparent that the maximum price that could be paid for kernels would be in the neighbourhood of £10 per ton and nuts about £3 per ton, delivered to the market. Such prices practically exclude nuts from consideration. By the time freight and oil expelling expenses incurred by manufacturers are taken into consideration it is probable that about £5 per ton would represent a gross return for kernels at port of export. Under present conditions in Fiji with high internal freights and hand decortication this price would hardly prove attractive to producers.

As pointed out by the Imperial Institute (*Bull.* 1920 xviii, p. 25.) " the chief difficulty in the exploitation of candlenuts is that of shelling the nuts. The shells are hard whilst the kernels are rather brittle and tend to cling to the shell so that although it is not difficult to crack the shells it is difficult to avoid breaking the kernels into small pieces which often adhere to portions of the broken shells."

From what has been said above it is obvious that for remunerative prices it would be necessary to decorticate the nuts and express the oil locally.

Without pre-treatment the nuts are particularly resistant to mechanical fracture and the kernels adhere firmly to the shell with the result that there is a high percentage of broken and bruised nuts.

In order to cut down the cost of decortication several experiments were carried out on a parcel of 24 lb of old nuts of varying sizes. The total number of nuts was 1,044 of which 94, equivalent to 9·0 per cent. floated on water and were discarded.

The following methods were adopted:—

(*a*) crushing without treatment;
(*b*) boiling for five hours, standing in cold water overnight and crushing;
(*c*) heating in hot-air oven at 140 degrees C. for five hours, standing in cold water over night and crushing;
(*d*) heating in steam oven at 100 degrees C. for five hours, standing in cold water over night and crushing;
(*e*) Philippine method, burning on open ground with straw, followed by sprinkling with water and crushing.

The following table summarises the information obtained:—

TABLE I.

| Process. | (*a*) | (*b*) | (*c*) | (*d*) | (*e*) |
|---|---|---|---|---|---|
| Weight of nuts | 2 lb | 2 lb | 2 lb | 2 lb | 2 lb |
| Number of nuts | 87 | 87 | 87 | 87 | 87 |
| Weight of kernels | 9¾ oz. | 11 oz. | 10½ oz. | 11 oz. | 10½ oz. |
| Weight of whole kernels | 6 oz. | 8 oz. | 6½ oz. | 6¾ oz. | 7½ oz. |
| Weight of half kernel | 1¾ oz. | 3 oz. | 2 oz. | 3 oz. | 1½ oz. |
| Weight of residue | 2 oz. | ... | 2 oz. | 1¼ oz. | 1½ oz. |
| Per cent. of kernel to nut | 30·4 | 34·4 | 32·8 | 34·4 | 32·8 |
| Per cent. whole kernel to total kernel | 61·5 | 72·8 | 61·8 | 61·3 | 71·4 |
| Per cent. half kernel to total kernel | 17·9 | 27·2 | 14·0 | 27·2 | 14·3 |
| Per cent. residue to whole kernel | 20·6 | ... | 19·2 | 11·5 | 14·3 |
| Total number of whole kernels | 26 | 60 | 51 | 51 | 55 |
| Total number of whole kernels per cent. | 19·9 | 69·2 | 58·6 | 58·6 | 63·5 |
| Time taken to remove shell (minutes) | 40 | 20 | 20 | 20 | 20 |
| Appearance of kernel | white | white | brown badly burnt. | white | slightly burnt. |

The samples of two lb lots were shelled by a Fijian assistant in the times stated and it is to be observed that with experiments (*a*), (*c*), (*d*) and (*e*) the times were shortened by half; nevertheless, 20 minutes is excessive and it is considered that under task conditions this time could be considerably shortened.

The best results were obtained with experiments (*b*) and (*d*). Experiment (*e*) produced slight burning but the yield of whole kernels closely approached (*b*). The temperature of 140 degrees C. used in experiment (*c*) was excessive and led to extensive burning of the kernels. The boiling for five hours in water had the added advantage of permitting the clean removal of the kernel from the shell (Experiment (*b*) ) as is shown by the high percentage of whole and half kernels and the absence of residue.

The experiments indicate:—

(1) the shell can be softened by heat treatment followed by immersion in cold water.

(2) a temperature of more than 100 degrees C. leads to burning;

(3) boiling with water (100 degrees C.) permits the easy removal of the kernel from the shell leading to a greater percentage of whole and half nuts and little residue.

Although these experiments indicated that the shell could be softened and the times for decortication reduced by half the actual time taken to decorticate by hand is far too long and the work too tedious for the type of labour available in Fiji unless the work could be organised as a cottage industry.

The Director of Agriculture therefore considered that it might be possible to secure a machine for the decortication and with this object in view several firms were consulted and a small inexpensive hand machine was obtained for the purpose. Several experiments were carried out with this machine on untreated and treated nuts.

From a consideration of the results obtained in experiment (1) the pre-treatment methods were modified somewhat.

The following experiments were performed and the results are recorded in Table II.

(1) untreated nuts decorticated;

(2) nuts heated to 200 degrees F. for three hours, cooled for 12 hours at air temperature and decorticated;

(3) nuts heated to 200 degrees F. for three hours plunged into cold water and decorticated;

(4) nuts plunged into boiling water kept at boiling temperature for half an hour, then into cold water for two hours and decorticated;

(5) nuts burnt between straw (Philippine method) sprayed with cold water and decorticated;

(6) nuts burnt between straw cooled in air and decorticated.

TABLE II.

| Experiment number. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Number of nuts taken .. .. .. .. | 400 | 400 | 400 | 400 | 400 | 400 |
| Weight of nuts .. .. .. .. .. | 8 lb 6½ oz | 8 lb 10⅝ oz. | 8 lb 13⅞ oz. | 8 lb 5¾ oz. | 9 lb 9¼ oz. | 9 lb 4 oz. |
| Number of whole kernels obtained .. .. | 47 | 20 | 112 | 116 | 88 | 74 |
| Weight of whole kernels .. .. .. .. | 4½ oz. | 2½ oz. | 11⅛ oz. | 11¼ oz. | 10 oz. | 8¾ oz. |
| Per cent. whole kernel to nut (weight) .. .. | 3·3 | 1·8 | 8·1 | 8·4 | 6·5 | 5·8 |
| Weight of broken kernels free from shell .. | 11⅜ oz. | 1 lb 1 oz | 1 lb 3 oz. | 13½ oz. | 1 lb 2⅜ oz. | 1 lb 5½ oz. |
| Per cent. broken kernels to nut (weight) .. | 8·5 | 12·3 | 11·3 | 10·1 | 12·0 | 14·5 |
| Weight of smaller residue free from shell .. | 5¼ oz. | 10¾ oz. | 4 oz. | 4 oz. | 4⅜ oz. | 6 oz. |
| Per cent. smaller residue to nut (weight) .. | 4·0 | 7·8 | 2·8 | 3·4 | 3·0 | 4·1 |
| Weight of broken kernels with shell .. .. | 1 lb 5 oz. | 2¼ oz. | 1 lb 1½ oz. | 1 lb 3 oz. | 1 lb 4⅝ oz. | 13⅞ oz. |
| Per cent. broken kernels with shell (weight) .. | 15·6 | 1·6 | 12·3 | 11·2 | 13·4 | 9·1 |
| Number of whole nuts (unbroken) .. .. | 16 | 8 | 4 | 11 | 2 | 1 |
| Time for milling .. .. .. .. .. | 7 min. | 7 mins. | 7 mins. | 7 mins. | 7 mins. | 7 mins. |

Table (III) details the experimental conclusions derived from Tables (I) and (II). It shows the kernel recovery and the efficiency of the process in terms of total kernel recovery assuming equal machine efficiency. The efficiency of the machine in terms of whole kernel recovery for the pre-treatment considered is also indicated.

TABLE III.

| Experiment number. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Per cent. by weight of whole kernel (f.f.s.) .. .. .. .. .. | 3·3 | 1.8 | 8·1 | 8·4 | 6·5 | 5·8 |
| Per cent. by weight of broken kernel (f.f.s.) .. .. .. .. .. | 8·5 | 12·3 | 11·3 | 10·1 | 12·0 | 14·5 |
| Per cent. by weight of residue (f.f.s.) .. .. .. .. .. .. | 4·0 | 7·8 | 2·8 | 3·4 | 3·0 | 4·1 |
| Total per cent. *recovery of kernel material* (f.f.s.)—by weight .. .. | 15·8 | 21·3 | 22·2 | 21·9 | 21·5 | 24·4 |
| Expected kernel material recovery (f.f.s.) from Table (I) average.. .. | 32·8 | 32·8 | 32·8 | 32·8 | 32·8 | 32·8 |
| Loss of kernel material adhering to shell .. .. .. .. .. | 17·0 | 10·9 | 10·6 | 10·9 | 11·3 | 8·4 |
| Efficiency of process in terms of total kernel material assuming equal machine efficiency .. .. .. .. .. .. .. | 48·1 | 66·7 | 67·7 | 66·7 | 65·5 | 74·3 |
| Expected whole kernel recovery for 100 per cent machine efficiency (per cent. by weight), Table I. .. .. .. .. .. .. .. | 30·4 | 30·4 | 30·4 | 30·4 | 30·4 | 30·4 |
| Per cent. real whole kernel recovery .. .. .. .. .. .. | 3·3 | 1·8 | 8·1 | 8·4 | 6·5 | 5·8 |
| Efficiency of machine in terms of whole kernel recovery .. .. .. | 10·8 | 5·9 | 26·6 | 27·6 | 21·3 | 19·1 |

(f.f.s.) means free from shell. Percentages are based on whole nut.

The results in Table (III) indicate:—

(i) There is a greater loss of kernel material adhering to shell with the untreated nuts. Making allowances for experimental error similar losses are constant within the neighbourhood of 10 per cent for treated nuts.

(ii) Total kernel recovery is in the neighbourhood of 65 to 74 per cent. with treated nuts and only 48 per cent. with untreated nuts.

(iii) The probable whole kernel recovery with treated nuts is in the neighbourhood of 6 per cent. (excepting exp. 2) and about 3·0 per cent. for untreated nuts.

(iv) That whereas experiment six appears to be more efficient in total kernel recovery experiments three, four and five give a greater all round efficiency in terms of whole kernel recovery and machine efficiency.

(v) The experiments indicate that the type of machine is not particularly efficient.

(vi) The experiments are in close agreement with the findings in Table I, although treatment times have been shortened.

Considering these experiments from the commercial aspect it is probable that with satisfactory methods available for separating kernel material from the meat that a 65 per cent. recovery of kernel material from which the oil could be pressed locally by simple hand presses such as are used in Malaya and the Philippines, might lead to a useful small holders' industry. Whole kernel recovery was low with the machine used nevertheless it would be possible to export at least 6 per cent. of the nut in terms of whole kernel and up to 16 per cent including broken kernels provided the market was not too distant.

It is considered, therefore, that before a possible candle nut oil industry is completely rejected from the scheme of minor industries under consideration by the Department of Agriculture endeavours should be made (1) to effect machine improvement in order to obtain a greater yield of whole kernels, (2) to investigate methods of clean separation of shell from kernel material and (3) oil extraction both with and without decortication.

Work is at present proceeding along these lines.

## ENTOMOLOGICAL NOTES.

By

H. W. SIMMONDS, F.R.E.S.,
Government Entomologist.

WORKING in Taveuni, Elijah, Native Field Assistant, reports the presence of larvæ of the mosquito eating mosquito *Megarhines splendens*, in tree holes at Butha Levu. This insect was introduced from Java in 1931.

### FRUIT FLY PARASITES.

The recovery, at Nasinu, of the fruit fly parasite *Tetrastichus giffardianus* on the 23rd March last indicated that this introduction had successfully bridged the excessive wet conditions which had prevailed since its liberation in this locality on September 10th of the preceding year.

At Tamavua it was recovered on September 19th having, in this locality bridged the dry period of the previous five months.

Scarcity of wild host fruits renders it impossible to define the present position regarding this introduction, the above records are, however, encouraging.

### CLIDEMIA HIRTA (THE CURSE).

After an absence on leave of nine months it is interesting to note the marked further retreat of this pest, which has now completely disappeared from large areas where it was formerly a solid stand, some five or six feet high. Even in the wet Tholo-i-Suva area, the almost pure stand at 8½ miles is now completely gone, fern, mile-a-minute (*Mikania scandens*) and grasses having replaced the weed.

### SLUGS.

Whilst the Paris green-bran mixture remains a sound method of dealing with slugs, cutworms and similar pests, seedlings can, in small gardens, be largely protected by placing small pieces of wilting paw paw leaves on the beds. Slugs normally prefer wilting material and will congregate upon this, thus saving the young seedlings, whilst the slugs can be destroyed with a knife by going around once or twice a week with a torch.

A method of controlling cut worms is by the use of Flosol a proprietary article, manufactured by Electrical Chemical Industries Ltd. Filimone, a Native Field Assistant at Navuso, reports that, using this spray on young tobacco seedlings at the rate of four ozs. to eight gallons water and spraying when the plants were dry gave perfect control.

## VETERINARY AND ANIMAL HUSBANDRY NOTES.

### FOUADIN IN THE TREATMENT OF HEART WORM.

READERS will be interested to know that the outlook in regard to the treatment of dogs affected with *Dirofilaria immitis*, or heart worm as it is more commonly termed, is not now so hopeless as was formerly the case.

A drug which is marketed by various firms under the name of Fouadin or Fuadin is now available for the treatment of this condition. Results of treatment carried out both in Fiji and overseas indicate that the drug is definitely useful.

It is interesting to observe that the drug, which is a complex antimony compound, is named after the late King of Egypt. It was introduced into that country for the treatment of Bilharzia and Kala-azar. It is now extensively used in the southern areas of the United States of America for the treatment of filara in the dog.

Unfortunately treatment with the drug is not simple. The dose must be accurately computed according to the weight and condition of the dog. It is administered over a considerable period at daily or two-day intervals by injections into muscle, or better still, into a vein.

The treatment is sometimes severe on the dog. The animal loses condition and has rheumatic like pains but these sypmtoms pass off later as the drug is eliminated from the system.

# COCOA.

By

H. W. JACK, M.B.E., B.A., D.Sc.,
Director of Agriculture.

IN describing the world cocoa situation, the West India Committee Circular of some months ago stated that the present market trend was cheerful, in that consumption in the United Kingdom had increased materially in the last 2½ years. It also added that increased consumption was due to natural causes in that it was to be attributed to the cheapening of the manufactured article and to the general increases in industrial prosperity.

Cocoa prices have continued to show a steady improvement since early in 1935 for most ordinary grades, but for good grades such as Trinidad 1st quality, increases of prices have been substantial.

The present prices (October, 1936) in London for cocoa are approximately as follows:—

| | |
|---|---|
| Trinidad, fine and superfine .. .. | 63s.—66s. |
| Trinidad, fair to good . .. .. | 60s.—63s. |
| Grenada, good .. .. .. .. | 60s.—63s. |
| West African, good .. .. .. | 41s.—42s. |

High grade Samoan cocoa would correspond with similar Trinidad and Grenada grades.

In Trinidad, the chief area from which high class cocoas are derived, the growers are being subsided to the tune of ½d. per lb which is expected to cost that colony £100,000 per annum in each of the next four years. The condition of estate growers elsewhere is similar and nowhere are profits sufficient to permit of adequate expenditure on cultivation and general attention. The increased consumption and increases in shipments to England are, however, definite signs of improvement.

Production is expected to be fully maintained in the Gold Coast and to increase slightly in Nigeria for several years hence and selection work is likely to lead to increased production in Trinidad, where also efforts are being made to replace cocoa by other crops in such areas as are found to be unsuitable to the crop.

With regard to the possibilities of cocoa in Fiji, the crop has been grown commercially in a few districts but no data are available to indicate whether such ventures have proved profitable.

It has been grown on a very small scale at Nasinu under neglected conditions and produced small quantities of pods at irregular intervals, the fruit being freely attacked by the flying-fox and by rats.

Reports indicate that the Forestero variety and red Java type have been grown but as Criolo is grown in Samoa, no doubt some trees of this variety may also be found.

There would appear to be little chance of cocoa proving remunerative in Fiji under estate conditions on account of high labour wages, but as a small peasant's crop there should be distinct possibilities of it developing into a useful cash crop if good types are grown and if moderate attention is given to the preparation of the commodity.

Climatic conditions (temperatures, rainfall, winds) in Trinidad do not differ materially from those in Fiji and soil conditions in Fiji can be found largely resembling those of Trinidad, in fact many fertile valleys in Fiji,

provided that adequate drainage and wind protection are available, should be capable of producing fair cocoa crops if small growers can be induced to give the trees the necessary attention as regards shade, pruning, cultivation, &c., since the cocoa tree is sensitive to such care.

Young cocoa in Trinidad is given temporary shade by mixed cultivations including yams, maize, bananas, tapioca,pigeonpea, &c., and the same practice is already applied here in developing coconut groves, so that it could readily be applied also to cocoa.

Permanent shade is provided by planting lofty light shade trees at wide intervals through the plantations in Trinidad and Jamaica, and in Fiji there are several trees of a suitable character for the same purpose as well as for "wind breaks," which are essential ( a hurricane would be detrimental). At the same time it is doubtful if shade trees would be so necessary here as in Trinidad.

At present, in West Indian colonies, the only post planting cultivation given is a slashing of weeds and undergrowth twice annually which is not a hardship.

Difficulties would arise in the preparation of the crop for market, including the right stage of ripeness for picking, care in picking, handling, sweating, fermenting, drying and curing, but instruction and experience would soon remedy this trouble.

Marketing could be best done by co-operative methods through the Department of Agriculture or by large commercial firms in much the same way as copra is marketed at present, when large crops become available.

Cocoa is subject to several well-known diseases, of which the most likely to affect the crop in Fiji would be Pod Rot, Pod Canker, Dieback, Witch Broom, Thrips and Boring beetles.

It might be mentioned that cocoa exports have now been materially stimulated in Samoa by the improvement in prices and also that, recently, an ungraded sample of cocoa produced in Fiji was valued in London at 45s. per cwt., whilst had it been graded, the high grade portion of the parcel would have been valued at 60s.

It is also worthy of mention that New Zealand in the first nine months of this year imported more than £42,000 worth of raw cocoa, while proportionate amounts are imported into Australia.

In his report on a visit to Samoa in 1933, the Government Entomologist (Mr. Simmonds) reported that yields of cocoa varied between 5 cwt. and 12 cwt. per acre but estimated the average at 600 lb per acre from stands of 200 trees to the acre. This estimate of yield compares favourably with yields in British West Indies and in Ceylon.

There is little doubt that similar results could be achieved in Fiji in small selected areas, such as would be available to peasant farmers and that climatic factors, given moderate protection from winds, would prove suitable for the adoption of this crop by small holders.

Efforts are in progress to collect suitable seed pods for establishment of a cocoa nursery with a view to gaining the interest and co-operation of the native in this potential crop.

## SILOS AND ENSILAGE.

By

CHAS, R. TURBET, B.V.Sc., M.R.C.V.S.,
Senior Veterinary Officer.

Owing to the heavy rainfall and high humidity experienced in most of Fiji, haymaking as a means of conserving fodder is not practicable. Most farmers agree that the provision of extra feed, particularly in the winter months, is necessary if the best return is to be obtained from dairy cows.

The problem of supplying this extra feed is a serious one. Although it can be done by the maintenance of crops of para or guinea grass, green maize, or bean for daily cutting, the constantly recurring use of extra labour for this purpose is expensive.

To overcome the problem of provision of supplementary winter feed, the construction of silos and the making of ensilage is urged. A silo in Fiji should be built above ground level to prevent flooding and should be protected by an effective rain-proof roof.

The structure should consist of an upright cylinder with concrete walls. The dimensions may vary to suit the requirements of the owner. An averaged sized silo would be approximately ten feet in diameter by twenty feet in height.

On the side of the silo least exposed to prevailing rain, the continuity of the concrete is interrupted by the insertion of a series of removable wooden doors one above the other, reaching from a few feet above ground level to the top of the silo. The object of these doors is to facilitate the extraction of the feed from the silo.

The filling of silo requires some engineering ingenuity. It is easy enough to fill the lower levels through the doors, but as the height of the column rises, so must greater work be done to raise the feed. In well-equipped establishments, this is done by an endless belt fitted with cleats running between sideboards and over pulleys above and below. The belt runs at an angle of 45 degrees and may be worked by a motor or by hand turning. It is best to chop the fodder before filling the silo. This is done by a chaff-cutter operating at the lower end of the pulley. It can be so constructed that the chaffed fodder falls on to the endless belt.

The silo may also be filled by hand by men walking up a stairway, or enclined plank, or, if the silo is on a hillside, by a bridge from the hillside to silo top.

The fodder materials which may be put into a silo are varied. In Fiji we have a choice of maize, para grass, guinea grass, cane tops, dhal tops, sensitive plant and various beans. Mixtures of these would also be suitable.

The advantage of the silo for Fiji is that the ensilage is protected from adverse weather conditions.

There are no silos in Fiji—as yet, but the time has arrived when they should advantageously be constructed. Perhaps the best argument for their construction is that, generally speaking, the most successful farmers in other countries possess them whilst the less successful do not.

It may be mentioned that guinea grass, sorghum, maize, para grass, &c., which all grow well in Fiji are admirably suited for silo storage and are all capable of producing very heavy crops per acre.

## THE TREATMENT OF WOUNDS IN FARM STOCK.

By
ILISONI COKA,
Native Stock Inspector.

VERY often claims have been received from the owners of farm stock owing to injuries to their animals. These injuries may be caused through rough handling or working or in walking in the fields where contact with some sharp object may be the cause of the trouble. The animal should be caught at once and brought into a clean and comfortable place, where the operator can perform his work with no great difficulties, and the wound should be treated antiseptically.

If the accident is recent and the wound clean and aseptic immediate union should be attempted. The suturing thread should be boiled before use as in the case of all instruments used. The maintenance of an aseptic state during the treatment of wounds depends upon using (1) sterile instruments, and dressings, (2) Sterile hands, (3) sterilising the wound, (4) prevention of infection during the period necessary for the healing of the wound.

The possibility of suturing fresh, clean wounds should be considered. If the wound is a contaminated one and does not heal readily the stitch must then be removed and it must be treated as an open wound.

Before performing stitching, the hairs around the edges of the wound should be clipped and thoroughly disinfected, Great care should be taken that no dirt should get into the wound to cause contamination.

The interrupted stitch should be adopted, as it assures a more perfect union of the edges of the skin. If the wound is deep and different kinds of tissues are divided the suture must be made to join similar tissue and as muscle to muscle, &c. In this case catgut must be used.

In commencing stitching an opening should be left unstitched on the top and at the botton of the wound to ensure the free drainage of any putrid matter from underneath. This is best done by using a rubber tube well inserted into the opening and thoroughly syringed with an antiseptic solution. Eusol is one of the most effective disinfectants for this sort of wound. The preparation is made up of Boracic acid 50 grams. Chloride of lime 50 grams. and water 4000cc. These are mixed and stand for at least twenty-four hours. The clear fluid is then syphoned off and ready to be used. If Eusol cannot be obtained any sort of antiseptic solution could be used, such as weak lysol or salt solution. When the wound is closed it should then be dried off with Methylated Spirit, and then a preparation of antiseptic fly dressing should be coated on to the top of the wound. This preparation should be applied on the wound after each time of dressing.

The wound must then be syringed out three times daily until the healthy granulated tissues are formed and the wound healed underneath and no puss discharging from it.

In about seven or eight days the stitches can be removed and the wound treated antiseptically until it looks dry, when a dry dressing such as dusting powder can be applied to the wound.

Whenever bandgaging is necessary great care should be taken that the bandages are applied evenly and not too tightly, so that their presence may not give rise to an unhealthy condition of the wound from interference with the circulation of the blood.

Punctured wounds of any depth and small openings must not be allowed to close whilst there is the smallest symptom of discharge. Such wounds are healed by granulation and in the first place should be carefully examined for any foreign body.

## THE CARE OF DOGS.

By

RARIKUA S. VERA,
Native Stock Inspector.

THE feeding of domesticated dogs has more to do with their health than anything else. Therefore, regular feeding and proper food, including fresh clean water, is required. Most people prefer giving dogs cooked food and of course some foods such as rice, &c., must be cooked. But meat and milk can best be given raw. When feeding dogs with cooked food they will require two feeds daily. With raw food such as meat and milk, one feed daily is quite sufficient for them. Raw food once daily is prefereable, giving food such as boiled cabbage and other vegetables once or twice a week.

### BATHING.

The best way of bathing dogs is by using warm water and soft soap, washing off all the soap and finally using a weak warm solution of sheep dip. The dog is then dried. In giving the bath it is always better to start from the head because in starting from the middle of the back, fleas run up the head into the ears and around the eyes and hide there. After the bath it is better to take the animal for a walk than to tie it up. Some dog owners use carbolic soap but this is not correct as it irritates the skin and results in scratching which causes inflammation of the skin. Bathing them often is not too good, once or twice a week is quite sufficient.

### CARE OF THE SKIN.

It is very important to keep the skin clean and free from fleas and other parasites. Kennels or places where they are kept should be clean and mosquito proof and, finally, daily combing and brushing stimulates and cleanses the skin.

### WHY ARE DOGS DETAILED—LENGTH OF TAIL.

Detailing is practised with some breed of dogs. Fox terriers and others are best shown with their tails short. The best time to operate on them is when they are four days or a week old. Although this can be done at any age. In performing the operation on young puppies a pair of scissors and a sharp scalpel are necessary. Clip around the tail at the right length, apply spirit or iodine and tie a tape or string around the base of the tail to prevent bleeding—this may be removed one hour after the operation. The tail is then cut off and bandaged. If the tail is kept clean, free from dirt, no further treatment is required. The length of tail removed on fox terriers should be about two-fifths and spaniels about three-fifths. In removing the tail from older puppies and grown dogs a proper surgical operation with anæsthetic is necessary.

### MATING—CARE OF THE BITCH.

Mating is due when the bitch is on heat. Domesticated bitches should be carefully watched when they come on heat. First of all the lips of the valva start to swell up and redness and discharging is seen. The best way to keep the bitch from mating with any other dog, is to lock her up in a room or cage until her time of on-heat is over. Towards the end of this time mating can be done if desirable.

### WORMS IN PUPS.

Pups a few days old are known to have worms fully grown in them. Round worms are frequent in pups, such as Ascarides. Flat or tapeworms are found mostly in adult dogs. Pups get worms from food and water given to them if they happen to contain the eggs of the worm.

Pups with worms should be treated by giving them a worm mixture in the same amount of milk. It is much better to starve them first—no food at night and give them the dose next morning.

### HEART WORM.

Heart worm attacks adults. This worm is long and slender, the male measuring about five or seven inches, the female worm about ten to fourteen inches long. The female worm living in the heart discharges the larvæ into the blood. The larvæ remain in the body for several months and when they are fully grown, start to attack the heart. Spreading or carrying of this worm is done by mosquitoes. At night the mosquito feeds upon an infested dog by drawing the blood containing larvæ of the worm which it goes and distributes to another dog. Short haired dogs are likely to suffer more from attacks of mosquitoes than long haried dogs and therefore also suffer more from heart worm.

To protect dogs from mosquito bites it is best to keep them in mosquito proof kennels at night.

## VARIATION IN PASTURES.

By

C. R. TURBET, B.V.Sc., M.R.C.V.S.,
Senior Veterinary Officer.

To a careful observer of pastures it may have been noticed that on land which is subject to fairly continuous grazing or cutting the varieties of grasses and herbage predominant in a field tend to change over a period of years.

There are various causes for this phenomenon such as variation in the amounts and type of plant food in the soil, palatability to stock, nature of growth of the plant, variations in rainfall and temperature changes.

When a plant is newly introduced to an area it may find the various forms of plant food present in the soil in just the correct proportion and amount suited to the peculiar requirements of that particular plant. The result is then that this newly introduced plant grows better than varieties of older established plants in the field. If this new plant is a grass then it is found that the new grass will predominate in the pasture for some time, which may be years. Later on, the soil becomes depleted of the elements most favourable to this particular grass and it is seen that the grass ceases to predominate in the pasture. Another cycle then commences and some other plant begins to predominate.

When pasture land is left ungrazed a particularly palatable grass may be given a chance to dominate the pasture. Subsequently, if stock are allowed to graze the area and the grazing is continued for too long a period the palatable grass may be depleted in the pasture to such an extent that it becomes negligible. The stock in preferring the palatable grass and leaving the less palatable types, allow these latter plants to predominate.

A grass which is much relished by stock and which has an upright or stooling habit of growth is much less likely to dominate the pasture than one which has a spreading growth, throwing down new roots as it spreads. These latter grasses can be grazed much more closely and survive a greater amount of overstocking than the former.

Some plants require conditions having abundance of moisture and as long as rainfall is favourable to them they may predominate in the pasture. When the rainfall is deficient for this particular grass it may either die off or be retarded in its growth to such an extent that other plants or grasses become predominant. The condition of lesser rainfall in this case need not necessarily approach draught conditions.

On the other hand periods of dryness unusual to a country may stimulate the growth of a grass which is normally present but in small quantity.

During the recent period of unusually dry and cool weather grasses of the blue grass family, *Dichanthium*, appeared along roadsides in Suva, practically to the exclusion of other grasses in some areas. The factors of coolness and low rainfall were favourable to it.

The blue grasses are palatable and nutritious grasses and the above observations leads one to anticipate that they would be excellent for winter pasture in the dry zones of Fiji where conditions of coolness and dryness may reasonably be expected annually.

## THE CULTURE OF SOYA BEAN.

By

D. N. MALELI,
Native Field Assistant.

A LIGHT loamy soil is best for this crop but it succeeds in poor soil also if other conditions are suitable.

The bean requires thorough soil preparation to provide a good seed bed which should be fairly compact underneath, leaving the surface soil light and loose for two to three inches.

Soya Bean can best be sown between the months of September and February and it takes three to five months to reach maturity. A good way to sow is by hand in drills 30 inches apart allowing six inches between each plant in the rows, ultimately. This requires about 20 lb of seed per acre and the depth of sowing should not exceed two inches.

The seed take three to five days to germinate, unless the weather is very dry. Great care must be taken during the early stage of growth as the young plants will be damaged by birds eating the young shoots, and it is not a bad plan to cover up the rows with dry grass just after sowing for protection from this pest.

As soon as the young plants are through, one good cultivation should be given, and weeds must be kept down until flowering time when cultivation should cease. Hoe in dry weather if possible. The crop is easily ruined in the early stage when growth is slow if weeds are allowed to predominate.

### HARVESTING.

When leaves begin to turn yellow, and to fall, the time of harvesting is near. Plants should stand in the field till all leaves have fallen, and when the pods show sign of spliting, the plants should be harvested without delay. Plants should be cut with sickle, and left in small piles to dry in the field, if the weather is fine, turning over the piles if necessary, and if the weather is wet, removed to a dry shed. When the pods are dry and brittle they are threshed. It is very important to see that harvesting should be done during fine weather, but if weather is continously wet when the plants are ready for harvest, they should be cut and spread in a well-ventilated shed and dried again when favourable weather is available. If harvesting is delayed too long, much of the crop will be lost owing to damage by rain. After threshing the beans should be properly dried, packed loosely in sacks and stored in a ventilated place.

The yield varies from 14—40 bushels per acre according to conditions and is highest when the crop is row planted.

For soil improvement, soya bean can be ploughed in as a green manure if desired. It also affords an excellent fodder for cattle.

## GENERAL NOTES.

### BROOM MILLET.

BROOM millet which was recently introduced by the Department has been grown satisfactorily in alluvial soils, both in the wet and in the dry zone of Viti Levu. The fibre provides an excellent material for the manufacture of brushes of various kinds as a cottage industry and it is hoped that the cultivation may be extended, particularly through the schools, to form a useful cash occupation for the peasant. Several brushes made locally of this material, locally grown, were exhibited recently at the Agricultural Show and attracted some attention.

### SOYA BEAN.

This crop was introduced during the year and on alluvial soil in the wet zone formed a dense cover and produced a good crop of beans in a period of four to five months.

It is hoped that this crop may gradually be extended to Fijians with a view to its use in adding to their diet a most useful food crop, rich in protein, oil and vitamins. It is also of commercial value as it always commands a good market in the United Kingdom either as soya beans or better as soya bean oil, since the cake provides a nutritive cattle food for local use. Furthermore, the cake residues are now largely used, especially in the United States of America, as a basis of plastic materials in motor car construction and in other industries.

### TREE PLANTING.

Efforts are being made in co-operation with the Director of Education and the Secretary for Native Affairs to inaugurate an "Arbor" day in Fiji amongst school children. The reported approaching shortage of timbers and, in some areas, of firewood, indicates that a movement such as this may prove useful. The idea being that, on a certain day each year, each school child should plant at least one economic tree in a suitable and protected area adjacent to the school and that such planted trees should be given a little care from time to time. In this way, useful timber reserves can be built up in time, adjacent to each school and the school children may be given some bias towards tree mindedness.

### RICE.

Owing to two successive seasons which gave conditions unsuitable for this crop, prices have been exorbitant. Also, imports of rice this year have been very considerably higher than is usual amounting to 1,960 tons valued at £21,500 up to the end of September.

The present season shows signs so far of being favourable to the growth of rice and it is hoped that bumper crops will be harvested. Cultivation in all rice producing areas would appear to indicate a material increase in the area being put under rice this season.

### PINEAPPLES.

The Colonial Sugar Refining Company has made good headway with a large area of nurseries and the news of this new large scale venture by the Company is most acceptable as affording an additional means of remunerative employment to many Indians and Fijians in the vicinity of the Company's activities. The excellent quality of Fiji pineapples is well known and this new industry will be a welcome asset to the Colony.

## SISAL.

Sisal hemp is to be found in several patches in Fiji and apparently grows robustly under local conditions, but is not now treated for the extraction of fibre anywhere in the Colony. As sisal fibre is now valued at £27 per ton, its extraction should be worth consideration wherever the plant is growing extensively, provided that plenty of fresh water is available. It might be mentioned that Fiji imports annually some £7,000 worth of cordage, rope, &c., which might be produced in the Colony, if labour rates were reasonable. Small holders might also make more use of this plant in providing cordage for their own needs.

## VEGETABLE CULTURE.

Householders frequently lament the difficulty of growing good crops of vegetables in this Colony where soils are rapidly leached by frequent and continuous rains but as usual, where there is a will, there is a way. The chief deficiency of garden soils is in humus which retains moisture in the soil and in addition supplies abundance of plant nutrients. Humus can readily be made by collecting all sorts of organic waste, cut grass, weeds, leaves, fruit and potato skins, cabbage stalks, &c., and storing them under moist (not too wet) conditions either in a hole in the ground or in a large pile. To this heap of organic matter some cattle or horse dung, ordinary soil, a little wood ash and a trace of lime should be added roughly in the following proportions:—

| | |
|---|---|
| Organic waste residues .. .. .. | 400 lb |
| Cattle manure .. .. .. .. | 50 lb |
| Ordinary soil .. .. .. .. | 60 lb |
| Woodashes .. .. .. .. | 6 lb |
| Lime or coral sand .. .. .. | 1 lb |

The whole mass must be kept moist and turned over about once each month (in moist weather) for three months. Turning distributes moisture in the pile and ensures æration. After four months the manure thus made should be ready for use and should be fully incorporated in the soil after it has been thoroughly dug to a depth of 18 inches, fully weathered and afforded moderate drainage. Thus, a good soil ameliorant can be very cheaply made and if such piles of manure are maintained in constant succession, they will supply all the needs of most vegetables that can be grown in Fiji. If desirable, of course, additional fertilisers such as sulphate of ammonia and superphosphate can also be added, with benefit but these are best applied as top dressings to the soil after the seedlings have put on a little growth. It is hoped that this note may prove of use in the promotion of vegetable culture.

## DWARF COCONUTS.

Recently, Mr. Edward Duncan broadcasted from Suva studio an interesting and instructive discourse of his experience with the Malayan dwarf coconut which dates back to 1921 when he received 800 seednuts mostly of the yellow variety.

He pointed out that the dwarf coconut, owing to its truly dwarf characteristics, as exemplified by its length of leaf, short stature, its early bearing and its small nuts, appeared to be comparatively resistant to damage by storms and hurricanes. For the same reason he mentioned that dwarfs could readily be planted at much closer intervals than the ordinary " talls " so that each acre of land could carry twice as many " dwarfs " as of " talls."

He continued that, although 7,000 " dwarf " nuts were required to produce one ton of copra (as against 6,000 of the ordinary " talls " in Fiji) his experience showed that this figure was well within the capacity of the trees growing under the good conditions of Taveuni.

He added that the Malayan " dwarf " was only suitable for planting under good conditions and near sea level, that it commences to bear at 3-4 years old and at 15 years of age the average length of trunk is about 12 feet. Thus, he pointed out that under good conditions the Malayan dwarf is capable of producing twice or even three times as much copra as the ordinary " tall " palms as grown in Fiji and which average about 7 cwt. of copra per acre.

It is of interest to note that in a recent number of the *Malayan Agricultural Journal* (September, 1936) yields 31 cwt., 29 cwt. and 34 cwt. of copra per acre are recorded from large blocks of dwarf coconuts for the years 1933, 1934 and 1935 respectively on one well known estate in Malaya, which estimated a crop of 35 cwt. for 1936. The dwarf area of this estate was planted in 1920 and since 1928 the copra yields exceeded 19 cwt. per acre per annum.

It may be mentioned that this Department of Agriculture has a small plantation of " dwarfs " in bearing on which selection experiments are in operation.

## FORESTS.

It may be of interest to state that the following " talk " on Forests, prepared by Dr. H. W. Jack (Conservator of Forests) was recently broadcasted to Fijians in their own language by courtesy of the Suva Studio.

The forests in Fiji are the source of many of the necessaries which are readily available to the independent peasant and the town dweller.

Thus, the forests provide a large reserve of good fertile soil in which food crops are grown; they provide the materials utilised in the building of houses and in the making of furniture; they supply the logs required for the erection of bridges and fences, and the manufacture of export fruit cases. They supply wood fuel for warmth and cooking The trees yield materials which are converted to clothing, which supply lighting, medicines, cordage, weapons, rafts, boats, edible fruits, and enormous numbers of other products which play a part in the daily life of the Fijian. The forests also shelter pigs, game birds, and fish and provide reservoirs of clean water from which streams and rivers arise to supply drinking and washing water, and ready means of transport. Thus, to the Fijian the forest is a never failing source of supply of the indispensable materials of life and hence, its immense utility must be readily realised if he gives any thought to the matter.

Unfortunately as civilisation advances, large tracts of forests are felled to provide land suitable for agricultural development, to provide access roads and grazing grounds and care should be taken so that such areas are adequately protected against soil erosion—the loss of the fertile top soil, as well as subsoil, by heavy rains and exposure to wind and sun. In such areas also, the lack of the more valuable and commonly used timber trees is soon felt and the effects of the practice of shifting cultivations in the reduction of soil fertility is early apparent.

It is also well known that forests play an important part in affecting climate, especially the rainfall, which may be materially altered not only in amount but in incidence by their destruction, and the effect of such climatic changes on agricultural operations is obvious.

The forests on mountain slopes are of particular value in that the foliage of the trees protects the ground from the mechanical disintegrating effect of heavy rains, and the forest soil below, being rich in vegetable matter, acts as a sponge and absorbs the water gradually and gradually releases it.

Where the hills are well covered by forests, the heavy rains are absorbed and the danger of floods is greatly reduced, so that a heavy downpour of rain produces a slight rise in the level of the rivers; while in times of drought river levels will fall slowly, gradually drawing on the reserves of water held in the spongy soil of the forests.

In comparison, where the hills are denuded of forest, every rain storm will give rise to innumerable torrents which sweep away good fertile soil, often laying bare the underlying rocks; the rivers will flood and damage crops and property and will quickly subside, because they have no reserves of water on which to draw; while in times of drought the rivers will dwindle to a mere trickle, which may even prove insufficient for the needs of the people living in its vicinity.

The forests of Fiji are quite equal, under scientific management, to the task of supplying indefinitely all possible future requirements and even of providing a balance of our better class woods for export, whereas the average imports of timber amount to about £19,000 each year at present, and much of our forest is uneconomic to work but improvement in this direction would not be difficult.

This brief note is intended to indicate the very great value of the forests to the inhabitants of the country and their general indispensability in the economics of the people. Therefore, it is hoped that the value of the forests will be realised and that they may be accorded good treatment in order that their value may be fully maintained and improved.

## AGRICULTURAL SHOW.

The Department of Agriculture as is usual, put up a comprehensive exhibit at the Show which was held in Suva on 19th October, to illustrate the lines along which work was being done. The chief feature of the exhibit was a standardised small copra drier which attracted much attention as did the very fine samples of copra made by Fijians using the new driers. Other exhibits included tobacco and a tobacco spinning machine, cotton, broom millet (and brushes made from it) vegetables (24 kinds) condiments, areca-nuts, rice, maize, soya bean, dhal, gram, fruits (15 kinds), cocoa, tea, coffee, sisal, kapok, sann hemp, cover crops, arrowroot, ginger, economic timber and fruit trees and some 40 ornamental flowering and foliage trees and shrubs.

Poultry husbandry was represented by the display of a type of fowl house and run containing pure bred poultry which is recommended for local conditions and which attracted considerable notice. The progress of the dairy industry in Fiji was portrayed in two instructive graphs while a model pigsty and types of pig and cattle feeding utensils served as useful demonstrations.

Some giant toads, hawksbill turtles and cases of economic insects proved a constant centre of interest and there was a comprehensive display of local fodder grasses under glass, and of pathological specimens.

An interesting display of sugar cane varieties, standardised cultural methods, pests and samples of various grades of sugar was put up by the Colonial Sugar Refining Company and proved very attractive.

In the native competitive section which was organised by the Department of Agriculture the most prominent feature was the display of excellent copra put up by " exempt " Fijians using the new type of Kiln which is now fast coming into use by progressive Fijians. There was also a good display of native foodstuffs and two attractive district exhibits. Indians for the first time, figured as exhibitors and put up a few comprehensive but small exhibits.

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# AGRICULTURAL JOURNAL

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## EDITORIAL.

THIS number of the *Agricultural Journal* opens with a note regarding the retirement of Mr. H. W. Simmonds, O.B.E., F.R.E.S., Government Entomologist, from the Department of Agriculture after sixteen years of valuable work and loyal service.

It also contains an informative article by experienced officers of the Veterinary staff on the keeping of pigs in Fiji.

This industry needs stimulation in order to reduce our imports of pork and to augment supplies of cheap meat so that the natives may be enabled to vary their diet more than they do at present for their general physical welfare.

The article indicates the best breeds of pig to suit local environmental conditions, describes the essentials of sanitary housing and stresses the need for clean water.

The necessary food components are mentioned and the need for a balanced food ration is emphasised if the best results are to be obtained.

Brief notes are added indicating the chief diseases which occur locally and methods of controlling them.

There can be little hesitation is stating that if the general instructions contained in this article are reasonably followed pig raising locally should prove a profitable side-line for dairy farmers and others.

An interesting comparison of the effectiveness of certain lures used in the trapping of fruit flies, is described by the Government Entomologist. The experiments show definitely that under local conditions the Queensland lure is the most efficient.

Some notes regarding the ability of Fijians as agriculturists are compiled by Mr. W. L. Parham, who has had much valuable experience in the working of Fijians and no little success in instructing them in the elements of agricultural practice.

He indicates the chief difficulties which confront the average Fijian who, given the incentive of a steady market, would undoubtedly prove himself a producer of raw products of no mean order.

He also mentions a few points which demonstrate the utility of small agricultural substations which this Department is now endeavouring to establish in Fijian areas and indicates the potentialities of the native as a self-reliant settler on his own land.

The Department of Agriculture is taking a lively interest in settling Fijians on their lands, as it is considered that this practice will ultimately prove of most value to the race.

In a short article by Mr. C. M. Dass, Senior Indian Field Assistant, the history of the evolution of the hybrid cotton No. 172 is traced. This cotton has been developed to suit local environmental conditions under which it gives heavy crops and it also proves of good marketable quality in England.

Mr. Dass has had long experience with cotton breeding work and this account should be of general interest as the hybrid No. 172 is likely to prove a valuable asset to the Colony.

As a result of a recent visit to Australia Mr. B. E. V. Parham has compiled for this issue a few useful notes regarding Queensland forest trees of potential value to Fiji.

It may be stated that seeds of most of the trees mentioned have already been obtained for trial in Fiji.

A brief description of an attempt to acclimatise the famous spartina grass to local conditions for the purposes of consolidating soil adjacent to rivers, lakes, drains, &c., is provided by Mr. Surridge and is of general interest as a record of the work.

The Inspector of Produce (Mr. A. B. Ackland) gives a short summary of the position of the banana export trade which should prove of general interest to the public, to shippers, and especially to commercial firms, since it is well recognised that the Fijians put their banana sales' money into very quick circulation. The loss of the Australian market has been a heavy blow to the local banana industry, the quota system has stabilised the trade in New Zealand, and there are limited prospects for the development of the banana trade with Canada.

The importation from Hawaii of another parasite of potential utility is reported by Mr. Simmonds in a brief note on the "Fruit Fly." Already some colonies of the new parasite (*Dirhinus sp.*) have been distributed to certain areas.

The local Indian method of extracting coconut oil is briefly described by Mr. S. Ramjan, Indian Field Assistant, and may prove useful as well as interesting.

In a note on the lime requirement of Fijian soils Mr. Blackie (Government Chemist) records the intensity of the acidity and shows that this varies little with depth of soil. He indicates that the lime requirement in Fiji varies from two to seven and a half tons per acre but that it is usually unnecessary completely to neutralise the acidity. Light dressings of lime, however, improve our soils and for bananas, sugar, citrus, &c., up to five tons per acre proves advantageous. Our pastures would benefit by liming but at present the high cost of lime would render useful applications of doubtful economic value.

Some brief but interesting notes on samples of soils from Koro and Lau by Messrs Blackie and Charlton prove that these areas contain rich fertile lands very suitable for many crop plants and it has formerly been noted that bananas from Koro are of excellent quality and unusually free of disease.

Some aspects of copra improvement are put forward in a short article which indicates that instruction aiming at the general practice of improved methods has made material progress and promises to develop further.

One of the main causes of the inferiority of South Seas copra is known to be the result of the practice of Fijians of selling "green copra" to Indian or Chinese shopkeepers for curing mainly by primitive, and often insanitary methods which should be discouraged drastically.

Means for discouragement of this mal-practice are available but have not in the past been enforced and it is now considered that with the tendency of the Fijians towards more independence they should welcome the opportunity of doing their own work, particularly as by so doing their personal remuneration would be materially enhanced.

The Department of Agriculture aims at the betterment of the Fijian agriculturist and with this end in view will continue to strive for the improvement of the copra industry which provides a crop essentially suited to the temperament of the Fijian. The crop also proves remunerative and of interest to a number of European planters, who are anxious to help in its improvement and who would generally favour some form of compulsory grading with a view to improving the reputation of the Colony combined with some enhancement of financial returns.

An interesting account of the present position of the Colonial Sugar Refining Company's Stock Farm at Yanggara is given by Mr. H. M. Stuchbery, Government Veterinary Officer, which indicates what can be accomplished in Fiji with cattle and horses under wise and continuous management.

Some further notes regarding the habits of the giant toad are given, which indicate its usefulness.

And the history of the development of the weed known as the "curse," is traced together with the methods which enabled it to be controlled.

New Public Health Regulations have recently been published and are of particular interest to dairy farmers in that the regulations are now made to apply to the entire Colony whereas previously they only applied to the Suva area. Hence all dairy farmers should study them carefully for their own benefit.

It may also be remembered that the import of cattle from Australia is temporarily suspended owing to the present epidemic of "Three-day sickness."

In addition, some brief notes of general interest and a few reviews complete this number of the journal which it is hoped will be read with interest.

The Department of Agriculture performs a number of useful and necessary services for the public and for the Government Departments and inquiries on all branches of agricultural work are always welcomed and will be attended to as expeditiously as possible subject to the limitations of staff.

The valuable work performed by the research officers of the Department is generally recognised and much appreciated but little is known of the difficult tasks carried out by the Field Staff under trying conditions which demand much patience and preseverance in dealing with native races.

The organisation of the Department now allows for a European Agricultural Officer in each of five agricultural Divisions into which the Colony has been divided and these officers are always at the disposal of agriculturists of all classes and communication with them is invited.

Under each Agricultural Officer a small number of native and Indian Field Assistants are employed through whom it is hoped much instruction and general assistance to the Fijians and Indians will be rendered.

This subordinate staff is gradually gaining the confidence of the Fijian and it is hoped that agricultural progress will continue as confidence in the Department deepens.

## RETIREMENT OF MR. H. W. SIMMONDS.

MR. H. W. Simmonds, O.B.E., F.R.E.S., came to Fiji in 1919 and in February, 1920 was appointed to the Department of Agriculture, Fiji, as Government Entomologist.

On reaching the age limit, Mr. Simmonds retired in January of this year after 16 years of conscientious, loyal and meritorious service.

At the time of his appointment four major problems were requiring the attention of the Department of Agriculture, namely:—

1. The Scale, *Aspidiotus destructor*, of coconuts.
2. The coconut leaf moth, *Levuana iridescens*, which devastated the coconut crops.
3. The "Curse," *Clidemia hirta*, a weed covering large areas of land.
4. The leaf mining beetle of coconuts, *Promecotheca reichei*.

With regard to the first of these problems, Simmonds was sent to Tahiti where two parasites of the "Scale" were reported to be present and these he successfully introduced to Fiji with greatly beneficial results.

The second problem, the coconut leaf moth (*Levuana iridescens*), had been known in Fiji for some 40 years and Simmonds was despatched to Malaya in 1925 with the object of collecting and preparing for export to Fiji, the parasite, *Ptychomyia remota*, of the moth *Artona catoxantha*. He successfully worked out the life cycle of the parasite in Perak State and arranged for the despatch of a large colony to Fiji, living on 85 coconut seedlings growing in five wire gauze cages. Although some 20,000 larvæ of the *Artona* were shipped, only 315 parasites (*Ptychomyia remota*) reached Fiji alive. From these surviving parasites, numerous large colonies were bred and distributed to make one of the most spectacular successes of entomological history, the *Levuana* pest still being completely under control as a result of this valuable work which is worth many thousands of pounds annually to the Colony.

In 1927 Simmonds brought from Honolulu a colony of the "Lantana" bug, *Teleonemia lantanæ*, which has since materially deterred the spread of this weed in the drier areas though its value in the wet zone is much hampered by long spells of rain.

In 1930 Simmonds proceeded to Trinidad on a mission to introduce a thrips (*Liothrips urichi*) with the object of stemming the rapid progress of the weed, *Clidemia hirta*, known as the "Curse." The insect was successfully introduced and achieved remarkable success over large areas of the weed, which are now replaced by useful herbage with much benefit to dairy farmers and others by the consequent reduction of weeding costs and the resulting better pastures.

In the control of the coconut leaf mining beetle (*Promecotheca reichei*) Simmonds also played a part in conjunction with his colleagues, notably Taylor who successfully introduced the parasite, *Pleurotropes parvulus*, from Java. This parasite continues to render effective control of the beetle.

During a visit to New Zealand Simmonds was able to convince the authorities there that the Mediterranean Fruit Fly did not exist in Fiji and as a result the citrus trade with New Zealand was reopened to the advantage of Fijian producers.

Simmonds performed valuable services in many other investigations concerning pests such as the blue rat tail weed, the cotton stainer, the banana borer, the citrus and guava fruit fly and others and the results of his researches and his numerous scientific publications containing valuable records will long benefit the Colony.

Mr. Simmonds as a man, endeared himself to many friends by his natural charm, modesty, reticence and refinement and counts numerous friends in his profession in many parts of the Globe.

By his colleagues in the Department of Agriculture he has always been very highly esteemed because of his natural traits as well as his immense fund of useful general information on agricultural and horticultural affairs in the Colony, which has always been freely at the disposal of members of the Department and many others.

As a horticulturist, Mr. Simmonds is a keen observer of nature, always maintains a garden full of beautiful blooms, and many of the best type of hibiscus now to be seen in Suva owe their origin to him.

In recognition of the very valuable services to the Colony rendered by Mr. Simmonds, His Majesty King George VI at his Coronation, graciously bestowed on him the honour of the O.B.E. which he justly merits as a fitting conclusion to his loyal service in the Department of Agriculture.

This is the first occasion on which any such honour has been granted to an officer of this Department for services in Fiji and all his colleagues appreciate fully the honour thus bestowed on the Department and heartily unite in congratulations to the worthy recipient.

The staff of the Department tender best wishes to Mr. and Mrs. Simmonds and hope that they may both be long spared to enjoy well-earned retirement in good health, happiness and prosperity.

## A METHOD OF MAKING GHEE BY PEASANT FARMERS.

By
SILAS RAM JAN,
Field Assistant, Western Division.

THE milk for ghee making is boiled gently for some two hours or more, and allowed to coool when a few drops of lemon juice are added. The whole is then allowed to form a junket by "souring." Approximately 24 hours after adding the lemon juice the "thick" milk is churned. The implement for churning consists of a split bamboo or a six-sided piece of wood which is rotated rapidly backwards and forwards by a short piece of rope. The violent churning results in the formation of a rather frothy butter on the top of the milk. This "butter" is skimmed off and the churning continued until all "butter" is extracted. During churning, cold water is added to assist in the formation of the butter. The butter is then washed in clean cold water three or four times to remove strong odours, heated, strained and bottled. It should not be over heated at this stage or the flavour will be destroyed and the ghee rendered tasteless.

## PIG HUSBANDRY.

By

C. R. TURBET, M.R.C.V.S., B.V.Sc., Senior Veterinary Officer,

and

C. KOSTER, Stock Inspector.

IN spite of considerably more interest being shown by dairy farmers in pig raising for the supply of local butchering requirements, it is still found necessary for some pigs to be imported for this purpose. The inference from this is that the local pig raising industry is capable of being extended.

Further, when normal local requirements are satisfied by locally bred pigs, it would appear that by judicious propaganda among housewives the local consumption of fresh pork could be greatly increased beyond what is, at present, considered as the saturation point. For instance, if each family in Suva alone had one more meal of pork each week than they are having at present, it is evident that a large number of extra pigs would be required to satisfy such increased consumption. In fact, why not eat more pork and less mutton. The aim of pig husbandry should be to make Fiji self supporting in pork requirements and the industry profitable to those engaged in it. Sheep mutton on the other hand must be imported since at present, Fiji produces little mutton and sheep breeding is not likely to develop with any great rapidity.

The retail prices of pork and mutton are very similar and both meats are equally palatable. Pork however, is marketed much younger in Fiji than the equivalent mutton which is from the carcasses of adult imported sheep. One therefore, purchases a more tender cut of meat in purchasing locally bred pork as against imported mutton.

The prosperity of our local people, many of whom derive their livelihood from the land, depends upon their obtaining a good and ready market for their produce and hence a greater consumption of locally bred pork would help materially towards prosperity, even if in a small way.

### SUITABLE BREEDS.

To be successful, pig raising must not be carried on in a haphazard manner. It has been ascertained by scientific observation and by practice that successful pig raising in Fiji is dependent upon the adoption of certain methods which have been found suitable to our requirements, the utilization of certain breeds of good foundation stock and the proper control of diseases.

Five breeds of pigs have at times had their waves of popularity in Fiji. A short description of each of these breeds is given below as a matter of general interest.

*Tamworth.*—This breed has undoubtedly been in Fiji for many years and crosses of the breed are to be seen among the wild pigs of these islands. In fact, of modern domestic pigs the Tamworth breed most resembles the wild pig. This is evidenced by the long legs and snout, hardiness, vigor, muscular strength, and the prolific breeding qualities of the sows. The breed is bright tan in colour. The proportion of lean meat to fat is probably greater in this breed than any other domesticated variety. It is greatly in demand, therefore, as a bacon pig but on the other hand is used for crossings to increase prolificacy and the proportion of lean meat to fat in pigs which tend to the other extreme.

*The large white Yorkshire.*—For bacon production this pig shares favour with the Tamworth which it resembles in its large size, length of body and the high ratio of lean meat to fat in the carcass. A fair amount of daylight is shown under the body; the face is of medium length and of course, the colour is white. The breed shows a rapid rate of growth and hence early maturity is a strong point in its favour.

*The middle white Yorkshire.*—This breed is more compact and shows much less daylight underneath than the large white. The face is very short and dished. The length of body in proportion to girth is not so great as in the Large White. The breed is essentially of the fat type of pig and matures early. The colour is white and is noted for its ability to transmit the white colour to the offspring, irrespective of the colour and breed of the pig with which it is mated. This factor is of utmost importance when breeding to supply pigs for pork to a constant market. The adult size of the breed is less than that of the Tamworth or Large White and it is usually classified as a general utility or pork pig.

*The Berkshire.*—Black skin and hair are distinctive features of this breed which in general conformation somewhat resembles the Middle White. It is a blocky, low set breed of a general utility or pork type and the adult is of medium size. The face is usually very short and dished.

Owing to their black colour as well as to the general excellence of the breed they have been introduced to all tropical and semi-tropical lands where it is generally considered that their black colour proves advantageous in strong sunlight. The breed has long been popular in Fiji.

*The Large Black.*—Whilst the four breeds already mentioned have rigid ears the "Large Black" is provided with long thin black ears reaching almost to the tip of the nose and drooping well over the face. The skin colour is black. In size the breed does not equal the Tamworth or Large White, nevertheless the pig has great length. The shoulder and jowl are light in proportion to the hind quarters. The lean meat is well proportioned and breed matures early.

All of the above breeds thrive well in Fiji and the actual choice of one of them as a farmer's pig is largely a matter of individual fancy. There are, however, two factors of importance to be considered in deciding which breed is to be utilized. The first is that white pigs are at present in favour with local butchers and the second is the availability of breeding stock. The Large Black is the least common breed both locally and in neighbouring Dominions. The other four breeds mentioned are fairly plentiful, but breeding stock of any breed is difficult to obtain in Fiji and the importation of breeders in the first instance is no doubt the best policy.

On account of the lack of pigment in the skin of white pigs, considerable prejudice formerly existed against these pigs in lands subjected to strong sunshine. This prejudice still exists in some countries where total hours of sunshine are high and where natural shade is scarce, but in Fiji, there is a large proportion of cloud and natural shade is plentiful. Furthermore, the method of housing advocated by the Department of Agriculture and adopted by most pig raisers in Fiji, provides sufficient protection from strong sunlight so that very little trouble is experienced among white pigs from sunburn.

Since there is no bacon industry, pig breeding in Fiji is entirely for the fresh pork trade of and the above mentioned pure breeds, Middle White and Berkshire are probably most suitable. Next in order would come Large White and Large Black which are of about equal merit, whilst the Tamworth is least suited to local conditions. As already mentioned, however, the Tamworth crossed with Middle White or with Berkshire provides a very suitable pig for the pork trade.

HOUSING.

Because of the presence of the kidney worm of swine in Fiji, it is necessary to modify the usual methods of pig husbandry as practised in other countries. It has been observed that where pigs are allowed access to the usual type of earth floored pig run or paddock, sooner or later the earth becomes infected with eggs or larvæ of the kidney worm as well as other intestinal parasites and it becomes an uneconomic business to attempt to raise swine for the butchering trade on such land.

A type of housing suitable to the particular requirements of Fiji has been evolved and adopted by practically all farmers who supply local butchers. The essential feature of this housing is that concrete floored sties are provided and fitted with adequate protection from sun and rain and the means of frequent flushing with clean water. Particulars of these sties are available on application to the Department of Agriculture. The sows farrow in these pens and remain with the litter until the latter was weaned. At no time are the young allowed out of the concrete floored sty. After weaning the sow may be allowed out to graze. The young pigs on the other hand are confined in the sty at all times. Should the litter be a large one, it will become necessary to divide the litter as they grow in order to prevent overcrowding in a sty. The young pigs are kept in these concrete floored sties until they are ready for marketing at about six months of age.

Formerly the writers advocated that all pigs, including boars and sows, should be confined to the sties. Although this practice has advantages in the control of kidney worm, there are certain disadvantages to be considered so that now the original plan is modified to allow both boars and sows some grazing. These adult animals however, should be provided with adequate sanitary sties.

A well laid concrete floor is essential in a sanitary sty. The partitions and walls may be made of one of several types of material to suit the pocket or fancy of the owner. Among these may be mentioned concrete, sheet or corrugated iron fixed to wooden or iron frames, wood and strong pig wire. The advantage of the solid type of end walls and partition is that of isolation and rigidity. A disadvantage is that the solid walls may tend to make the pens hot. When partitions of pig wire are used there is free ventilation and so the sties are cooler. This, however, breaks down the isolation between sties, so that in the event of disease appearing it is spread more easily from sty to sty. The end and back walls at least of a unit of sties should be of solid material to provide shelter from cold winds to which pigs generally show low resistance.

About half the total floor space of the sties should be roofed, as a protection against both rain and sun. When an iron roof is used, it is well to cover the iron with cut grass or coconut leaves as an insulation against excessive heating of the iron on days of strong sunlight.

The floor area of a pen or sty capable of housing a sow with her litter should be about 100 square feet. A convenient dimension would be 13 feet by 8 feet. Subsequent to the weaning of the piglets their number in any one pen should gradually be reduced as they grow so that not more than six pigs are contained in a pen when ready for the butcher, *i.e.*, at about 100 lb weight.

At one time a removable wooden sleeping floor was advised at one end of the pen under the shelter of the roof. It is now found that the floor is unnecessary, the pigs doing quite well on plain concrete. This means a considerable saving in the cost of construction of the sty.

To get the best and most economical growth, pigs should not be exposed to excessive rain and dampness. To avoid this the floor of the sty must be

given sufficient slope to allow fluids to run off quickly. The slope should be from back of the sty to the front, when the back is the covered portion. The pigs will then have reasonably dry sleeping quarters under the roof.

Housed in sties of the type mentioned above it will be found that pigs have reasonably clean habits. They will always go to one part of the sty to get rid of their excreta. Feeding arrangements should be in the front of the sty for convenience in operating.

There is some danger of heavy sows killing young piglets by crushing them between their body and the wall of the sty. To avoid this accident, it is well to provide a guard rail of two inch round iron piping or wood around the sides of the farrowing pen placed at a distance of nine inches from the wall and at a height of about nine inches from the floor. This buffer serves adequately to protect the young pigs from being crushed.

Drainage from the floor of the sties should be allowed to flow into a common open cement drain outside the sties leading to a covered liquid manure tank. The adoption of this type of disposal of pen washings will help to keep down flies and other vermin as well as provide a convenient source of garden manure.

An abundant supply of clean water is a very necessary adjunct to every pig sty and will result in healthy pigs being produced with a minimum of drudgery. It is essential, in fact, for the control of the kidney worm.

It has already been mentioned that an open run with grazing may be provided for breeding sows and for the boar. The difficulty is to keep this exposed earth free from kidney worm infection. The area therefore, should not be overstocked. Swamps, damp corners and mud holes should not be included in its boundaries. An open porous or sandy soil is best but difficult to obtain in many districts in Fiji.

## FEEDING.

Since it is advised that young pigs should be entirely raised on concrete they become dependent upon man for their existence, growth, and development. They are unable to select their food or to balance their ration. The pig owner must therefore provide sufficient food containing the correct proportion of contained nutrients.

The essential components of food consist of several different compounds and elements including proteins, carbohydrates (starch and sugar), fats, minerals, vitamins and water. Some food are rich in one of these ingredients whilst poor in another, thus, giving a badly balanced food ration. When a food has the various components present in the correct proportion for the best utilization of the food by the body it is said to be well balanced. The balance of food relates to the proportion of digestible protein to the digestible starch plus the heat equivalent of the fat. This is expressed as the nutritive ratio. The other components, minerals, vitamins and water must be present in sufficient quantity. In addition to being present in sufficient quantity, lime and phosphorus for the growing pig should occur in about equal quantity.

Because it is desirable that young pigs should grow rapidly, the proportion of protein to carbohydrate and fat, (*i.e.*, the nutritive ratio) should be high since protein enters largely into the production of flesh and other animal tissues except fat. At the same time because of the rapid growth of the pig, minerals should be abundantly supplied to allow for good development of bone and blood.

As the young pig grows towards maturity the nutritive ratio of the food should become gradually wider, in other words less protein food is required in proportion to starch, sugars, and flats. Simply stated, this means that

young pigs being raised for market require much richer food than say the adult boar or weaned sow. The pregnant sow and the sow with litter requires rich food, since she is providing for the nutrition of other bodies that her own.

The farmer will wonder how he is going to balance the pig's food without knowledge of the chemical constituents of the food and his difficulty is appreciated. What has already been written rather indicates a scientific ideal for pig breeders but also it gives a basis for thought in computing a balanced ration, an illustration of which will later be given for a 40-lb pig.

In the meantime a table of locally available food stuffs computed on a basis of 100 lb of each material will not be out of place.

TABLE A.

| Feeding stuff. | Dry matter. | Total digestible nutrients. | | | Nutritive ratio. | Mineral Ash. |
|---|---|---|---|---|---|---|
| | | Crude protein. | Carbo Hydrate. | Fat. | | |
| 100 lb | lb | lb | lb | lb | | lb |
| Meat tankage .. | 92·5 | 58·0 | .. | 12·7 | 1: 0·6 | 10·5 |
| Skimmed milk .. | 9·9 | 3·1 | 4·6 | 0·9 | 1: 2·1 | 0·7 |
| Coconut meal .. | 92·3 | 18·4 | 37·6 | 17·1 | 1: 4·1 | 5·7 |
| Pumpkin (field) .. | 8·3 | 1·1 | 4·5 | 0·5 | 1: 5·1 | 0·9 |
| Crushed maize .. | 88·7 | 6·9 | 69·0 | 3·5 | 1: 11·1 | 1·3 |
| Para grass .. .. | 27·2 | 0·8 | 14·0 | 0·3 | 1: 18·4 | 6·6 |
| Kumalas .. .. | 31 | 0·9 | 24·2 | 0·3 | 1: 27·7 | 1·1 |
| Cassava .. .. | 32·6 | 0·6 | 26·4 | 0·2 | 1: 44 | 1·0 |
| Molasses, (cane) .. | 74·2 | 1·0 | 58·2 | .. | 1: 58·2 | 6·4 |
| Bananas, (green) .. | | | Analysis not available. | | | |

The above foods are placed in their order of richness as shown by their nutritive ratios. Although skimmed milk and field pumpkin appear high in the list, the proportion of dry matter to water is low. In skimmed milk also there is too much protein as compared with carbohydrate and fat, *i.e.*, the nutritive ratio is too close.

Perusal of the list indicates that crushed maize is rich in these latter two ingredients *i.e.*, the nutritive ratio at 1: 11·1 is too wide. It will be seen therefore, that by feeding skimmed milk and crushed maize, in correct proportion that a ration of correct nutritive ratio can be obtained.

An example of such a ration is as follows:—To feed a pig of 40 lb a correctly balanced daily ration of 2·33 lb of total dry matter having a nutritive ratio of 1: 4·4 (which is approximately correct for the size of pig selected for illustration) quantities as set out in the following scale would be required:—

TABLE B.

| Feeding stuff. | Total feed. | Total dry matter. | Crude protein | Carbo-hydrate. | Fat. |
|---|---|---|---|---|---|
| | | lb | lb | lb | lb |
| Skimmed milk .. | 1 gallon | 1 | 0·31 | 0·46 | 0·09 |
| Crushed maize .. | 1½ lb | 1·33 | 0·103 | 1·035 | 0·0525 |
| Total .. | .. | 2·33 | 0·413 | 1·495 | 0·1425 |

$$\text{Nutritive ratio} = \frac{\text{Carbohydrate} + (\text{fat} \times 2{\cdot}25)}{\text{Protein}}$$

$$= \frac{1{\cdot}495 + (\cdot1425 \times 2{\cdot}25)}{\cdot413}$$

$$= \frac{1{\cdot}8156}{\cdot413} = \frac{4{\cdot}4}{1}$$

This ration as it stands appears to be a good one. It is not quite correct however because maize is particularly poor in calcium (lime) and rich in phosphorus. The ration would therefore, contain too much phosphorus as compared with lime. The effect of this after prolonged feeding might cause a disease of the bones of the pig resulting in paralysis of the hind quarters. The above ration should therefore be adjusted by adding lime or ground limestone in the form of a lick or direct to each feed. Some green feed should also be added to the ration as a source of roughage or crude fibre and of vitamins present in that type of food.

Without going so far as to have a ration balanced with mathematical exactness, a farmer, by reference to Table A, can form a very fair idea as to whether he is balancing the ration or not. For instance, if he selects meat tankage as one food stuff he should go low in the list for selection of other food stuffs of the ration, *i.e.*, meat tankage, crushed maize, kumalas, or cassava.

In this brief article it is not possible to prescribe a ration suitable to all farmers since feeding stuffs available to each will vary but the Veterinary Division of the Department of Agriculture will formulate for inquirers, balanced rations for growing pigs to suit available food stuffs.

## DISEASES.

Few countries are so fortunate as Fiji in the absence of acute infectious diseases of animals including pigs. Those diseases which are present may be controlled so that practically no loss from disease should occur under good management.

*Tuberculosis.*—When this disease is not controlled losses by condemnation of carcasses at slaughter-houses will be experienced. Infection in pigs is usually traceable to feeding pigs unsterilized skim milk from cows infected with tuberculosis. Therefore, to eliminate the disease from the piggery, it is necessary first to eliminate it from the cow herd, or to sterilize the skim milk by boiling it before feeding it to the pigs.

In spite of the above precautions, heavy infection of pigs with tuberculosis has been found in a few instances in Fiji where infection has not been from feed but from contact with other infected pigs. In these cases no milk was fed. Where infection of this type occurs the disease can be eliminated by applying the tuberculin test to the herd and eliminating those animals found to be infected. The sties should be sterilized by washing with disinfectants and by putting the blow lamp flame over wood work and feeding troughs.

*Posterior paralysis.*—It has been found that this disease in Fiji may be due to one of two causes or both of these may act together. Severe infestation with the kidney worm may cause it but more commonly it is the result of mineral deficiency or an ill-balance of the lime and phosphorus present in the diet. To avoid the occurrence of this disease it is well to add a small quantity of mineral mixture to each feed as a routine procedure.

A suitable mixture for this purpose would be:—

| | |
|---|---|
| Sterilized bone meal .. .. .. | 40 lb |
| Air slaked lime.. .. .. .. | 40 lb |
| Common salt .. .. .. .. | 19 lb |
| Sulphate of iron .. .. .. | 1 lb |

This mineral mixture may be added to the feed at the rate of one pound to each 100 lb of feed mixture, calculated on a dry basis, (for instance one gallon of skimmed milk is equal to one pound of dry food). The mineral mixture should be thoroughly incorporated in the general ration so that all pigs receive their proper share.

Pigs already infected with posterior paralysis should receive the above mixture but such animals should also be provided with a soft comfortable bed of dry grass. Food and water should be made easily accessible to the diseased animals.

*Kidney worm Disease.*—This is the most serious disease of pigs in Fiji where special precautions are not taken to control it. On the other hand when proper sanitary measures are taken practically no losses should be experienced.

The female worm lays her eggs in cysts which open into the uretors of the pig. The eggs therefore, pass out of the body by way of the urine and so contaminate the surrounding floor. Fortunately, the egg cannot immediately reinfect another pig as it takes from 24–36 hours for the egg to hatch and the young embryo worm is not able to reinfect another host until four more days elapse. The infective larvæ may live under damp conditions for up to five months. Infection of the host may be through the mouth or skin.

From the above it will be observed that if the pigs are kept on concrete floored sties and these sties are cleaned thoroughly by flushing with water more often than once in five days, no embryo worms will reach the infective stage and so infection will not occur.

Open earth floored yards in which adult breeding stock are allowed to run should be well drained and maintained free from swamp areas and mud holes. The earth in these yards and more particularly areas where pigs are accustomed to urinate may advantageously be sprayed with 10 per cent. solution of copper sulphate (blue stone) at the rate of ten gallons per 100 square yards. By this treatment the larvæ of the parasite are killed without harmful effect to pigs inhabiting the land.

That young pigs can be raised for the butcher free of Stephanurus (Kidney worm) infection in spite of association with infected mothers has been conclusively demonstrated in Fiji. The absolute prevention of the ultimate occurrence of the disease on adult stock cannot be assured when the system of partial housing and partial freedom in open pasture is adopted. Nevertheless this latter practice is reasonable with adult stock. They will breed many litters before falling victim to the disease and by adopting the above suggestion of spraying the yards and of eliminating wet places, almost complete freedom should be experienced.

*Intestinal worms.*—Infestation with these parasites may make pig raising totally unprofitable. However, the adoption of the same measures as are described for the control of the kidney worm will result in freedom from intestinal worms.

## CONCLUSION.

Pig raising for the local fresh pork market in Fiji is a profitable side line for dairy farmers when conducted on lines described in this paper. The local market is not yet fully supplied but the extent of development for the above market is limited.

## REFERENCES.

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## FRUIT FLY TRAPPING EXPERIMENTS.

By

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AT the suggestion of the Director of Agriculture the following fruit fly trapping experiments designed by the writer, were carried out at Nasinu Citrus Station, where Mr. H. R. Surridge, Agricultural Officer, South, supervised the field work.

Whilst trapping the common Fijian fruit fly in an ordinary glass trap, using the Queensland lure (Scrubbs Ammonia, Vanilla and water) has given encouraging results, it was decided to test the value of this lure, as opposed to Clensol and Pollard which have proved of value against other species elsewhere.

In these experiments *Chætodacus passifloræ* was the only commercial fruit fly captured, although in Suva *Ch. xanthodes* has been found to come readily to the same lure. The work was carried out during the whole month of March, when fruit fly in guava fruit probably reaches its maximum.

The traps were used with and without trays and the results are tabulated as follows. A large number of Sarcophagids were also captured, as well as a few other flies, wasps, ants, &c. The pollard being the least specific in its attractiveness and the Queensland lure the most so.

TRAPPING RESULTS WITH TRAY.

| Queensland lure. | Pollard. | Clensol. |
|---|---|---|
| Male. Female. Ind.<br>18 438 26<br>482<br>% F = 96 | Male. Female. Ind.<br>34 181 0<br>215<br>% F = 84 | Male. Female. Ind.<br>13 39 0<br>52<br>% F = 75 |

TRAPPING RESULTS WITHOUT TRAY.

| Queensland lure. | Pollard. | Clensol. |
|---|---|---|
| 53 526 5<br>584<br>% F = 91 | 29 100 0<br>129<br>% F = 77 | 10 41 0<br>51<br>% F = 80 |
| | Totals. | |
| 71 964 31 | 63 281 0 | 23 80 0 |
| 1,066 | Grand total.<br>344 | 103 |

It will thus be seen that the Ammonia-Vanilla gave a total of 1,066 as compared to 344 for the pollard and 103 for the Clensol. The percentage of females was also higher for this lure, being from 90–96 per cent. as compared to 77–84 per cent. for pollard and 75–80 per cent. for Clensol. The presence or absence of the tray beneath the traps made no appreciable difference.

*Condition of Females.*—An examination was made of one batch of females to ascertain the condition of the ovaries, the batch being trapped with the Ammonia-Vanilla lure and consisting of fourteen females and one male.

Of the fourteen females, five had full ovaries ready to oviposit, three had six or more ripe eggs, three had fewer than six ripe eggs and the remaining three had small partially developed ova only.

*Queensland lure without vanilla.*—As it had been stated that, in Queensland, it had been found that the vanilla was unessential in this lure it was decided to test this statement also. The results were interesting, the Ammonia-Vanilla giving 83 males, 923 females and 13 indetermined, a total of 1,019, whilst without the vanilla only 48 males, 396 females, and 3 indetermined, or a total of 447 were trapped. It will thus be seen that the vanilla doubled the efficiency of the lure.

It thus becomes evident that in the so called Queensland lure, (Ammonia-Vanilla) an attractant of very considerable efficiency is available, especially so to the females, as indicated by their large proportion in the traps intercepted prior to ovipositing. It is also of interest to note that the only commercial fly taken at Nasinu, merely nine miles from Suva, is *Ch. passiflorœ* and the *Ch. xanthodes* which has at times been the dominant species in the Suva traps, when using the same lures, has not once been taken. As this species has been recorded as present in Fiji for many years and as it uses both the guava and the granadilla in which to oviposit particularly the latter, it is puzzling to understand why it should not be in evidence at such a little distance from Suva, not one having been seen amongst the thousands of fruit flies examined in the past four years.

The Queensland lure consists of Scrubbs Ammonia, Vanilla and water in the proportion 1 tablespoonful ammonia, 1 teaspoonful Vanilla, and 1½ pint water.

## THE FIJIANS AS AGRICULTURISTS.

By
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IN the Fijian's own language, he is commonly styled the " taukei " (owner) denoting his status as owner of the bulk of the land in the Colony. It is almost safe to say that the average Fijian feels still a sort of right to lands alienated before Britain took charge and terminated the sales of land.

During the sixty years since the Cession the Government has followed the policy of endeavouring to increase the variety,, and the quantity of commercial crops grown by the Fijians. Within recent years the Department of Agriculture has been particularly active in providing instruction, and in assisting the natives with the marketing of their produce. But to critics who assume that such interest is being displayed late in the day, one must repeat that these activities of to-day are but the present form taken by the same interest in the natives' welfare that caused Sir Arthur Gordon to organise the growing of tax crops. In passing, one may mention that in the cultivation by Fijians of tobacco, maize, and cotton there are still many evidences of the value of the instruction given whilst that system of taxation was in force in Fiji. Indeed some Fijians ask for a revival of the system. This reflects credit both on the quality of the instruction given, and on the ability of the Fijians to absorb it.

Yet it is evident to the most superficial observer that the natives are not making reasonably full use of their lands. The reasons for this are so controversial, as well as so varied that they cannot be dealt with in this article.

Briefly the difficulties of the ambitious Fijian may be listed as:—

(*a*) want of incentive;
(*b*) ignorance of implemental agriculture:
(*c*) restrictions of the communal system;
(*d*) impossibility of being thrifty in the face of native custom;
(*e*) inferiority complex.

The rapidly improving system of communications in Viti Levu at least, is bringing both new desires and new burdens on the Fijian—thus gradually providing the incentive lacking hitherto. For instance, it is evident even to the hospitable Fijians that villages on the main roads cannot welcome non-paying guests; so the way-faring native nowadays either has to possess money or else starve—" kana wai " being the current term for soothing the pangs of hunger by drinking water.

The Agricultural Instruction of the Fijians in their own homes is being so rapidly organised by the Department of Agriculture that soon no Fijian need plead ignorance. A large staff of trained native assistants are now engaged in most parts of the Colony working under the supervision of European Officers, Demonstration plots (substations) are being established at key points, so as to give practical proof of the possibilities of crops new to the areas concerned. In instance of the practical utility of substations some of the work carried out by the Fijian staff of the Demonstration Farm at Ndombuilevu in Ra Province, may be mentioned. This substation was commenced seven months ago, with a staff of one Native Field Assistant and two native students. The reports include the following:—

(*a*) instruction in cotton growing throughout the province;
(*b*) organisation of a settlement of fourteen Fijians;
(*c*) supplying of seed to Indians, and to Fijians;
(*d*) roadside ornamental plantings;
(*e*) growing and supply of nursery plants;

(*f*) growing of experimental plots of cotton;
(*g*) successful liberation of Giant Toad (*Bufo Marinus*);
(*h*) collection for identification of diseased leaf specimens of the coconut acutely attacked by Scale (*Aspidiotus destructor*, Sign.), and liberation of the necessary parasites;
(*i*) erection of house and store and the planting of food crops;
(*j*) making of drains, triangulation of area, &c.

The restrictions of the communal system and of native customs are self evident, but their discussion is beyond the scope of this journal.

What may be termed the "inferiority complex" of the Fijian is passing rapidly; but it has been, and will continue to be a drawback that so many Fijians themselves refuse to believe their race capable of competing with the immigrant races. This is particularly noticeable in the cases of men of rank and of power who have reasons of self-interest for desiring the maintenance of old ways, and so find temptation to discourage the hopes of the ambitious. Such pessimism is seldom insincere and is noticeable also as regards many Europeans with long experience with Fijians. The commonest remarks heard about Fijians comment on their laziness, wastefulness, ignorance, and want of ambition. Too often there are good reasons for such comments, but often also one is inclined to wonder how one's own race would fare under similar conditions. The Fijian race is facing a critical epoch, and requires all the friendly encouragement possible. In agriculture the officers of the Field Division of the Department of Agriculture find much to do in stimulating, and in maintaining the desirable ambitions of the Fijians. But it would be impossible to do this, if one did not know of the potentialities of the natives as agriculturists.

In the first place the Fijian is an expert gardener with a thorough inherited knowledge of the needs of every crop customarily grown in his home district. Planting methods vary greatly from Province to Province, and always with good reason. For instance kumalas (sweet potatoes) are generally planted on mounds, but in certain dry districts are set first in holes to provide them with shade; and finally are hilled up with the onset of the rains.

The most spectacular evidence of Fijian skill is to be seen in many and extensive terraces in some of the hill districts. In grass country one may observe whole hill-sides terraced and with complete irrigation systems; including the provision of bamboo pipes where necessary. Carefully designed dams were made, and planted with shrubs for strengthening purposes. It is no exaggeration to say that such terrace systems extend for miles, and though many are visible on grassy slopes, yet many more are hidden by forest growth. A few of these terraces are still utilised by the few modern representatives of the numerous families which once maintained these extensive gardens.

In connection with these terraces it is interesting to find that a system of rotation had once been practised. Ndalo was the main crop but at times the terraces were dried off and planted with yams.

Another commendable practice still to be seen commonly in the hill districts is the building of bamboo palisades on steep hillsides to retain the soil of yam gardens. In the hill peoples' dialect there is a specific term for these contour barriers to erosion, and it is a purely Fijian idea, yet to all intents it is a practice of modern anti-erosion science which the Department of Agriculture is desirous of bringing into common use by the immigrant agriculturists in the Colony.

The Fijians understand well the varying types of soils and have terms expressive of the differences. Both the top-soil and the sub-soil is considered in selecting land. The quick response of tobacco to soil conditions

has been realised, and the Fijian chooses the soil which will give him any particularly desired result. In a recent discussion over the site of a plot for tobacco the Fijians stated that an alluvial gravel sub-soil was particularly desirable for the crop.

Maintenance of soil fertility was not studied except in the case of ndalo terraces; and these, entailing much skill and labour in their construction, were necessarily worth maintenance. Otherwise the Fijian quite reasonably as he has abundance of land, changes his garden to new sites—abandoning the once or twice cropped land to revert to the wild state, and so become renovated in the course of time.

Another random instance of native skill concerns the planting of bread-fruit suckers. These are very delicate, hence a palm leaf is plaited around each one as a protection.

An extraordinary point about the Fijian in agriculture is that it is the one activity in which he is and was an individualist. Any average Fijian can show where his father or grandfather had gardens, but one hears little or nothing of communal plantings. Such communal activities are and were for specified public purposes only, and any misuse of such for private purposes causes bitter disputes.

Each self-respecting individual is and was dependent on himself for his food supply. The desirable suitor in a Fijian girl's eyes is the industrious gardener, and I have known an aged man win a young wife with general approval for that reason. Formerly the garden was the only place where the native had any home life; and that is largely so still. The Fijian away for a few days on his distant and secluded garden is a very different man from his often languid seeming self in the Koro. With a house usually built convenient to an ample water supply he is in the open air from dawn till dark; and at night there is no crowded social gathering to tempt him to late hours and excessive yanggona. An important detail too is that for the time being, he is altogether his own master and able to plan his work free from unexpected and incessant calls on his time. It is doubtful if a man of any race whatever could ever accomplish much if beset with the incessant frittering away of his time in petty communal duties which cannot all be anticipated and be planned for accordingly.

Much of the Fijian's reputation for laziness has arisen from ignorance of his habits whereas left to himself, the native can undoubtedly fend for himself. The everyday ways of the Fijians are those of any other intelligent and industrious race.

From a wide experience of agricultural instruction amongst the Fijians the writer is convinced of their aptness to learn, but one must have something worth the teaching. For instance careless ploughing was terminated by teaching the English system of dry land ploughing which gave the men a new pride in their work, and they enjoyed it the more that the reasons were practical but not obvious.

There are some of the reasons why one is convinced that from being an expert gardener the native can become an equally expert and successful commercial agriculturist. It is not the intention in this article to deal with the how and the why of the exceptional obstacles with which the Fijian has to contend, but one may point out that, given opportunity, many a native becomes a frugal and a self-reliant settler on his own individual holding. The Department of Agriculture is taking a particular and an increasing interest in such settlers, and it is evident that in the success of these men lies the best hope for their race.

## FIJI HYBRID COTTON—NO. 172.

By

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FIJI Hybrid Cotton No. 172 is a type of the large family of economic plants, known as Gossypium, that was especially bred to suit Fiji conditions. As during the present season approximately two hundred acres of it have been planted it may be of interest to trace its origin and history. This brief description will perhaps convey to the layman something of the magnitude of the task in evolving a single type of cotton that will meet at least most of the requirements of the spinners.

In 1926 Mr. R. R. Anson, the Cotton Specialist then in charge of the Singatoka Experiment Station, received from the Empire Cotton Growing Corporation seed derived from five single plants selected by Colonel Evans (now Sir G. Evans, Principal, Imperial College of Tropical Agriculture) in New Guinea for trial in Fiji. These plants, designated K1, K3, K8, K11 and K24 respectively, were natural hybrids of two types of the Peruvian group. The first type, Kidney, (*Gossypium peruvianum*) possesses a robust bushy plant capable of growing well under very wet conditions and produces lint very short in length and coarse in texture and conglomerate seed—the mass of the seed resembling human kidney in shape whence the cotton derives its name. The Second type, Sea Island (*Gossypium barbedense*) possesses slender, upright plant producing long soft lint, is free seeded, and requires somewhat drier growing conditions.

Two of the New Guinea hybrids, K3 and K8, when tried at the Singatoka Experiment Station were found to possess lint intermediate in character, *i.e.*, moderately long and somewhat less coarse than " Kidney " and the seeds were more or less free. Two selections were made from each type (designated K3–1, K3–2, K8–1 and K8–2) for characters of lint and free—seededness, and were planted in separate blocks for observation and further selection during 1927–28. It may be pointed out that throughout breeding and selection work was guided by a definite policy—that of producing lint suitable for sale in England against super fine Egyptian cottons which commanded a select as well as a comparatively extensive market.

During season 1927–28 it was found that both K3 and K8 selections bred almost true to type, possessed 100 per cent. free seed, had improved in respect to ginning percentage and lint index, but little improvement was noticed in the length and fineness of lint. Multiplication plots were planted with seed obtained from progeny rows of K3–2 and K8–2 selections. K3–2 appeared to be more uniform in habit of growth and general plant construction than K8–2 and was earlier in reaching maturity. The yield of seed cotton obtained was almost double of that of Sea Island. At this juncture it was decided to eliminate K8 type and continue further selection with the K3 type.

Having attained free seededness, slight improvement in the quality of lint and uniformity of plant type, the next step was to effect further improvement the quality of lint without sacrificing yield.

In season 1928–29 ten single plant selections were made from K3–2 type which resulted in marked improvement in the length and fineness of lint. At the same time it was realised that to bring the K3–2 selection up to the standard of superfine Egyptian it would be necessary to introduce a further dose of the Sea Island strain into it. Accordingly five plants of K3–2 were " backcrossed " with Sea Island. These plants were named K3XS1, K3XS2, K3XS3, K3XS4 and K3XS5.

In 1929–30 the backcrosses were set out in five progeny rows. Two hundred and seventy-three plants were obtained as follows:—K3XSI=104 plants; K3XS2=9 plants; K3XS3= 20 plants; K3XS4=43 plants and K3XS5=97 plants. This was the first filial generation of the backcross and contained plants for the most part possessing intermediate character of plant-habit but differing somewhat in lint characters. All plants were self-fertilised, the process requiring daily attention. The plants and their produce were tested individually for fifteen separate characters both in the field and in the laboratory.

During the season 1930–31 the selections were planted into 273 progeny rows, necessitating the testing of over 7,000 plants in the field for plant, flower and boll characters. This being the second filial generation of the backcross the progeny split up into numerous types, most of which were deficient in some important character. Of the 7,000 plants tested in the field 6,500 were eliminated. The remaining five hundred plants or rather seed-cotton obtained from 500 plants was subjected to laboratory tests. Of these 241 plants were obtained from K3XS1 and 259 plants from K3XS5. All plants of K3XS2, K3XS3 and K3XS4 were eliminated.

During the season 1931–32 fourteen pure lines were isolated from five hundred progeny rows, five of the best being K3XS1–127; K3XS5–24; K3XS5–63 and K3XS5–172.

Samples of lint of the five pure lines were sent to England for spinners' reports during 1931–32 and 1932–33. At first K3XS5–24 seemed to be the cotton that would meet their requirements. Their preference then changed over to K3XS5–172. The laboratory tests carried out at the Experiment Station showed that K3XS5–172 was the better cotton of the two.

During the seasons 1932–33, 1933–34, and 1934–35 the backcross (K3XS5–172) was grown on small isolated areas at the Experiment Station along with Nos. 24, 35, 63 and 127. Crossing was however carried a stage further by introducing another dose of Sea Island into the backcross cotton No. 172. The second Backcross cotton was carried through all similar stages of selection and elimination as with the backcross No. 172 but the result has not been very satisfactory so far.

In 1935 the Director of Agriculture decided that single plant selections of the backcross No. 172 should be continued with a view to improving its lint characters since the cotton was considered to be of good marketable quality. Though slight variations existed in the quality and length of the lint it was gratifying to know that the goal set in 1926 had been attained and that a type of cotton has been evolved which continues the robust habit of the "Kidney" with the fineness of lint and other good qualities, of the superfine Egyptian cotton.

This year 1936–37 a number of progeny rows of the backcross or hybrid No. 172 are planted, some of which give promise of improvement in characters such as uniformity in length of staple and fineness of lint. Consideration is also being given to the usefulness of again backcrossing the double backcrosses to Sea Island with a view to increasing the length and fineness of the lint.

## NOTES ON SOME QUEENSLAND FOREST SPECIES.

By

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Agricultural Officer, Central.

DURING a recent visit to Brisbane, at the suggestion of the Director of Agriculture, Fiji a few inquiries regarding forest species of trees which might be useful for planting in Fiji were made and the present brief note summarizes the information obtained in the short time available.

The Forestry position in Queensland is roughly, that some planting of Exotics (*Pinus radiatus, P. caribæa, P. tæda*) has been done at great expense; but the policy is now entirely abandoned, the Department concentrating on native species. All Australian States are now turning to re-afforestation with native species—not exotics. Growth rates of Fiji kauri which I mentioned were regarded as quite satisfactory; and the failure of seedlings to persist unaided is apparently common to both Fiji and Australia. Recently new methods of handling the young plants of forest species have proved most successful.

*Araucaria Cunninghamii* (Hoop Pine) is the most important indigenous softwood of Eastern Australia and yields a valuable timber. The timber is used for all indoor work and for mouldings, panellings, ceilings and joinery. It is superior in toughness and strength to imported pinewoods. It is also used for the planking and decking of boats and small vessels. The timber has no odour and is excellent for butter-boxes. Six million super feet of Hoop Pine of flawless quality is annually converted into 3-ply in Queensland. The special value is the even, firm, softwood texture, ease of working, strength and durability; and the timber is non-aromatic and tasteless.

The small trees will not tolerate open root planting without shade—but planting out in tubes has proved 80 per cent. successful and costs about £10 per acre. The seed loses its viability rapidly so that fresh seed is most desirable. The seed is planted in prepared beds which are shaded—late spring planting, *i.e.*, between 15th October and 31st January is desirable—and very poor growth results if planted later than 1st March. This effect is cumulative and affects the subsequent growth over a long period. Tubing a plant consists of enclosing the root system within a metal cylinder (probably bamboo pots would be equally as good). After planting out, weeds must be suppressed for two or three years.

*Callitris glauca.*—Cypress Pine favours a sandy or loose soil. The timber is durable, is resistant to white ants, and is finding increasing use for flooring and lining. For windbreaks—*Cupressus lusitania* from South Africa has proved most successful One pound of seed would give 30,000 to 40,000 plants. This species is recommended for trial in Fiji.

*Agathis Palmerstoni.*—Northern Kauri Pine. The timber is softer and lighter than Kauri (N.Z.)—used for cabinet work, joinery, flooring, &c., and for butter boxes. The seed matures in late December and January and falls in late January and February during rains—seed collection is therefore difficult. The viability is much reduced after three weeks hence seed must be sown immediately after collection. Germination takes place in from 8–20 days. Loose sandy loam is most suitable—seed being covered by ¼-inch of sand. Moderate shading is essential during first year. Planting out in tubes has proved 90 per cent. successful.

*Grevillia robusta.*—Southern Silky Oak. This species shows very rapid growth and seeds well. The timber is mainly used for general building

purposes and for interior fittings giving a most serviceable cabinet wood—defective and short pieces are used extensively for fruit cases. The seedlings should be 3–4 months in nursery and trees should be kept thin and growing freely. This tree would be a cheap proposition in Fiji where it is already known to grow well; and might be particularly useful in several ways, *e.g.*, for early supplies of case timber—for shelter as used in Ceylon. The month old seedleaf seedlings should be transferred to pots (or bamboos). The tap root at this stage is only two inches in length and 90 per cent. survival is generally obtained. A spacing of 11 x 9 feet has been adopted tentatively in Queensland. The growth rate is most vigorous during the first six years, by which it is usually 30 feet high. In Kenya the following record has been made of plantation stands:—

| Age. | No. of trees per acre. | Volume per acre under bark. | Height. |
|---|---|---|---|
| 16 years | 472 | 2,065 c. ft. | 60 feet. |

*Eucalyptus species.*—Several species selected for trial in Fiji are among the most valuable for structural purposes and for re-afforestation. Several of them provide the timbers specified by the Fiji Public Works for building and structural work. The silvicultural requirements of the species are similar. They will not regenerate or develop in shade; being strong light demanders. The seed germinates best in sand the average germination being only 15 per cent. The seedlings should be transferred when two inches high. Forest Service efforts in Queensland are to produce Ironbark girders and pole-trees on as large a scale as possible; Red Stringybark, Tallow wood and Blue Gum are also receiving much attention.

*Bush Box—Tristania conferta* is regarded as the best Australian hardwood for bridge and wharf decking, for wooden tram rails, &c.,—and makes good bullock-yokes. It is classified as a good second-class general building hardwood. The tree favours sites of heavy continuous rainfall, and at its best becomes a very large tree—140 feet high with a basal girth of 200 inches.

*Cardwellia sublimis* is a large and massive-trunked tree: and produces the timber known as Northern Silky Oak—a highly ornamental cabinet wood supplying practically the whole of the present demands of the Queensland markets.

The Quondong (*Elaeocarpus sp.*) is already seen occasionally in Fiji. There is a large specimen in the Suva Botanic Gardens. The timber is white, easy to work, cuts cleanly, bends readily and it does not discolour with age. The trees favour the zone of heavy and continuous rainfall: and should produce timber useful for cases, &c.

The Queensland Forestry Department is very well organised and is most efficient and the work being accomplished is of a very high order. There is a wide range of climatic conditions throughout the State and a great variety in the vegetation types—and in many respects forest conditions in places are very similar to those in Fiji.

## THE GRASSES SPARTINA TOWNSENDII AND S. BRASILIENSIS IN FIJI.

By

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Agricultural Officer, South.

THE grass *Spartina Townsendii* was first observed in 1870 growing along the edge of Southampton Water. It has spread to many of the estuarine waters found along the south coast of England and the North coast of France. The plant is very robust, growing to about three feet high, has a strong rooting system which gives good anchorage and enables it to establish itself quickly and in dense patches under congenial conditions. Flowering commences in August and seed harvest about October-November. The strong rooting system has proved of particular value in that it enables the plant, once established, to quickly consolidate the ground, thus retarding the flow of water thereby causing the deposition of fine silt, &c., which builds up the level of the ground, an average of ten inches per annum being recorded in Holland. In Poole Harbour (Dorset) it has established itself in the comparatively hard mud and gravel flats favouring locations lying between high water mark and about six feet under that line. It is also found on the higher levels known as saltings and odd plants may be found in the seawall at the entrance to Poole Harbour. These characteristics have made it of value in the reclamation schemes on the East Coast of England, in the Zuyder Zee of Holland and elsewhere.

The grass, whether green or as hay, is stated to be palatable to stock.

In July 1933 some 100 planting sets of *S. Townsendii* were received by E. Duncan, Esquire, of Suva and Taveuni, from New Zealand, and handed over to the Department of Agriculture, Suva, for trial and observation to discover what value, if any, this grass would have in building up and reclaiming the mangrove and other mud flats in parts of these tropical islands. The sets were carefully washed in fresh water and planted out at one foot apart in a selected spot of mangrove or " tiri " mud in Walu Bay, Suva, which at high tide was covered with 4 ft.-5 ft. of water, while at low tide the first row was just above the water line.

A month after planting 40 sets were dead. Of the remainder, ten sets were left for further observation at Walu Bay, while 50 sets were transplanted to a sandy mud bank, on the right bank and near the mouth of the Rewa River. Sets were planted at one foot apart from a point one foot above high water mark to one foot below the low water line. Para grass (*Panicum barbinode*) was growing freely one foot above the highest mark of the *Spartina Townsendii*.

Plots were inspected at monthly intervals, those at Walu Bay had died out by December 1933, while those transplanted to the Rewa River gradually died out, only one set was reported as alive a year later, but this had died when the writer visited the plot, on return from leave, in March 1935.

The two sites chosen were not identical or comparative but represented the two main types of soil for which the characteristics of this grass would prove valuable, if establishment was possible.

The mud at Walu Bay was at all times soft and during sunshine was very hot between the falling and rising tides while the water was hot and turbid. At the Rewa River, the " soil " consisted of a mixture of " tiri " mud more or less overlain by river silt and coral sand, the water however, was usually clear with some admixture of fresh water on the falling tide especially when the river was in spate, and temperature would normally be high on the tide rising over the hot sand.

In both cases the contrast with the conditions obtaining in the plants native habitat and those found in Fiji was marked, the writer having—when on leave— specially visited Poole Harbour to note " local " and favourable conditions. In this case water temperatures rarely approach 60° F. and the mud flats were hard by comparison. With the failure of *S.Townsendii*, seed of S. *brasiliensis* was obtained from British Guiana by courtesy of the Department of Agriculture at Georgetown, in 1936, but on sowing failed to germinate. From the reports published in the *Agricultural Journal* of British Guiana Vol. 5, page 277, 1934 and Vol. 7, No. 3, 1936, of this grass it would appear to be more adaptable to tropical conditions.

## FRUIT FLY.

By
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Government Entomologist.

THE wild guava season appears to have been shorter this season than usual and this will probably shorten the season for efficient fruit fly work. Trapping experiments have been carried out and the interesting results detailed elsewhere, obtained. Disappointment has, however, been met with in that the parasite, *Tetrastichus giffardianus* which promised so well, and had such a high potential value, seems to have failed to bridge the long season of host shortage in these localities where it has been possible to test it.

Whilst it seems unlikely that it has everywhere failed to do so, the fact that it has failed in the considerable guava areas at Nasinu indicates an inability to cross the host shortage season in numbers sufficient to be of any value in the next guava season when, to be of value, its pressure is required early.

Due to the courtesy of the U.S.A. Department of Agriculture in Hawaii another parasite (*Dirhinus sp.* ?) which attacks the pupal stage of the fly was imported in March 1937. This insect is hardy and probably long-lived. It lacks, however, the high potential value of the *Tetrastichus*, since each puparium attacked yields only one adult, instead of the seven to thirty-five of the smaller species. On the other hand the author finds that it will also attack the house fly pupa, and as such, it will be provided with an alternative host to help it to bridge the season when fruit fly pupaira are practically non-existent. To date the following releases of this species have been made: Nasinu 327, Singatoka 200, Taveuni 90.

The local parasites began to show up in March and a collection made at Nasinu on the 31st March gave a 12½ per cent. parasitism by *Opius fijiensis*, Full. An undetermined chalcid was also bred out of pupæ collected in this district on three or four occasions.

## THE BANANA INDUSTRY.

By
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Inspector of Produce.

THE following is a brief survey of the banana export industry since the commencement of the quota system in 1932.

The beginning of the year 1932 witnessed a heavy fall in values for bananas on the Auckland market, shipments for the first two months realising average prices as follows:—

| | | | | | | |
|---|---|---|---|---|---|---|
| "Tofua," | 14/1/32 | .. .. | 19,783 | cases, | 8s. 0d. | per case. |
| "Niagara," | 22/1/32 | .. .. | 1,555 | ,, | 11s. 0d. | ,, |
| "Karetu," | 2/2/32 | .. .. | 2,754 | ,, | 11s. 0d. | ,, |
| "Tofua," | 11/2/32 | .. .. | 12,288 | ,, | 6s. 0d. | ,, |
| "Aorangi," | 18/2/32 | .. .. | 3,066 | ,, | 5s. 6d. | ,, |
| "Karetu," | 27/2/32 | .. .. | 3,368 | ,, | 7s. 6d. | ,, |

Although there was a slight appreciation thereafter it was not until October of that year that prices exceeded an average of 13s. 6d. per case. The average price realised over the whole year was 10s. 10d. per case. In the meantime a number of buyers had surrendered their licences and retired from the business and the Fijian growers had become extremely dissatisfied with the low prices fixed by the Banana Licence Board, 1s. 6d. per case for four months with an average of 2s. 3d. per case over the whole year, and in many cases refused to cut their fruit.

The fall in values dealt a serious blow to the banana trade of Western Samoa and the Cook Group of which New Zealand has control and on the 3rd June, 1932, a cable was received from the New Zealand Government seeking approval of a restriction scheme which had been discussed semi-officially some months previously. Under this scheme, to which the Fiji Government agreed, Fiji was allotted quotas of 12,000 cases per four-weekly period from January to April and from October to December and 9,600 cases for each period of four weeks from May to September. During 1933 these quantities were increased by 800 cases and 400 cases for each four weeks for the Summer and Winter periods respectively owing to the inability of the Norfolk Island Administration to ship its quota due to lack of transport facilities. Fiji continues to enjoy these additional quantities but it is understood that they may be returned to the Norfolk Administration should transport from that island to New Zealand be provided.

In September 1934 a conference of representatives of all the parties to the agreement was held in Wellington with the result that the claims of the New Zealand controlled groups of islands for a larger share in the market were, of necessity, conceded. The New Zealand Government was unable to agree that the market justified an increase in the total imports permitted, consequently, reductions had to be made in the Fijian and Tongan quotas to provide an increase for Samoa. The reduction was considerable. For 1935 the Fijian summer quota fell by 3,200 cases to 9,600 cases and by 2,400 cases to 7,600 cases for the winter period. Further, the new arrangement provided for reductions to 8,800 cases and 6,800 cases for the summer and winter periods respectively during the years 1936–1939. While the reductions were drastic, Fiji was secured against further reductions until the end of 1939 and became entitled to a share in any increase in the total admitted to New Zealand which any improvement in the market might justify during the period of the agreement. The Colony has been fortunate however, in that the inability of the Samoan Authorities to secure suitable transport for

the additional quantities permitted the transfer of large quantities to Fiji, and it was not until the "Matua" took up the running in September 1936, that the reductions were seriously felt. Since then, however, there have been shortages in the Cook Island quota from which Fiji has benefitted.

The New Zealand Government on representations from this Department of Agriculture, decided that as from the 1st January, 1937, the market could absorb slightly increased quantities and Fiji has been allotted additional quota as under:—

| | | |
|---|---|---|
| January to September | 560 | cases for period of 4 weeks. |
| October .. .. | 736 | ,, |
| November .. .. | 928 | ,, |
| December .. .. | 1,304 | ,, |

While the operation of this restriction scheme has provided difficulties in the administration of the banana export trade there can be no doubt that it has been of great assistance to the industry and that, without some such form of market control, exports would now be much lower than they are to-day.

A comparison of exports for pre and post quota periods does not show the effects of restriction on the quantities exported as there are other factors such as storms and floods which govern production and export. Thus, exports to New Zealand have not fallen below 136,000 cases in any year since the introduction of the quota whereas for 1930 and 1931, owing to hurricane and flood damage, exports were 84,500 cases and 97,600 cases respectively.

Following decisions reached at the Imperial Economic Conference at Ottawa the Australian market was reopened to Fiji to the extent of approximately 50,000 cases per annum by the reduction of the duty from 8s. 4d. per cental to 2s. 6d. per cental for that quantity. High hopes for an extension of Fiji's market for bananas were entertained but experience has shown that high charges in the Commonwealth, since reduced to some extent, and the heavy production of bananas in Queensland and New South Wales rendered profitable trading impossible except for a few months of the year. An additional handicap has been the uncertainty as to the provision of cooler space in the south bound steamers. The tariff reduction has applied since December 1932 but a total of only 40,245 cases—less than one year's quota—have been shipped from that date until the end of 1936.

The possiblities of the development of a market for bananas in Western Canada have received consideration for some time but it was not until 1932 that trial shipments, five in all, were made. These trials were unsatisfactory and were not followed up and further shipments were not made until shortly after the arrival of the present Director of Agriculture in September, 1934. On December 14th of that year a small shipment of 284 bunches and 74 cases was made and regular monthly shipments have been made since that date with profitable results, the maximum shipment being 2,430 bunches. The total quantity of fruit shipped to Canada from the end of 1934 until the close of December last was 33,384 bunches and 483 cases for which the growers received approximately £3,200 at packing stations. The demand is good, up to 4,000-5,000 bunches monthly, but the trade is hampered by a limitation to one ship per month, and by shortage of cooler accommodation on that ship during certain seasons.

The quality and pack of bananas exported to all destinations has improved considerably during the past few years. In 1932 the average net weight of fruit per case was between 80 and 85 lb, to day-100 lb net would be the average. In 1932 the Fijians produced 64·3 per cent. of all bananas exported

whereas for 1936 the percentage of fruit produced by natives and shipped was 80·2 per cent. There has been a gradual increase in the quantities exported from Viti Levu with a corresponding reduction from outer island areas where copra is the principal money crop the percentages being:-

| | *Viti Levu percentage.* | *Elsewhere. percentage.* |
|---|---|---|
| 1932 .. .. | 49·4 | 50·6 |
| 1936 .. .. | 66·7 | 33·3 |

Whilst the trade is but a shadow of what it was prior to the increase in the Australian tariff in 1921 it still remains a most important industry to the Fijians, particularly those in the inland areas of Viti Levu which are served by the Rewa River and its tributaries. During the past five years the growers have received in excess of £130,000 for their fruit, cases produced locally to the value of over £50,000, have been used, at least £60,000 have been expended in local transport, labour, supervision, &c., while overseas freight has approximated £140,000; and banana inspection fees paid to Government have amounted to £10,200. In addition, the shippers have enjoyed reasonably prosperous years excepting during 1932.

The Group can produce large quantities of good quality fruit provided that markets could be found, and it is unfortunate that the only large market within reasonable distance, Australia, is able to produce practically the whole of her own requirements.

## COCONUT OIL EXTRACTION BY PEASANT FARMERS.

By
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THE coconuts are husked, slit in halves and grated finely on a " Khurchni " (a serated edged steel tool). The oil is extracted from the grated " meat " by mascerating with hot water. Cold water is added to hasten the separation of the oil. The whole is then strained through wire gauge and the milk allowed to settle overnight. It is considered that twelve hours is sufficient time to allow the raw oil to rise to the surface. The oil is skimmed off in the early morning while still more or less solidified. The utensil containing the " milk " for settling should not be covered, particularly in hot weather as fermentation is induced with consequent frothing over and loss of oil. Then follows the boiling of the oil. The oil must be constantly stirred to prevent burning and the process is complete when a pale clear amber colour is obtained. Cooking takes two to three hours. The husked shell of the nut is used for fuel when cooking the oil as a steady smokeless fire is required. After cooking, the oil is strained through muslin and placed in containers. The oil extracted as above will keep fresh for up to six months in Fiji. About 220 to 250 nuts are required to make four gallons of oil, depending largely on the fineness of grating.

Coconut thus prepared serves as a substitute for " ghee " and to a certain extent mustard oil, and is used in making sweets, curries, &c. Some sections of the Indian community also apply it to the hair and body as do the Fijians.

## SOME ASPECTS OF COPRA IMPROVEMENT.

By

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Agricultural Officer, Islands.

DURING the past twelve months efforts have been in progress to interest the Fijians in the method of improving the quality of native copra in the Colony.

These efforts have mainly been concentrated on instruction in the erection and working of small copra driers, which have been found capable of turning out excellent copra provided that the routine of curing, as established by the Department of Agriculture, is reasonably closely followed.

Already over sixty of these kilns have been erected and are functioning satisfactorily and the resultant copra of good quality is gaining a premium of ten shillings per ton over the local prices for ordinary native sun dried copra.

Orders have been received for a further fourteen kilns which will be erected in the course of the next few weeks and it is anticipated that more orders will follow continuously for some time.

As the output of native copra forms approximately sixty-five per cent. of the total output from the Colony, continued improvement of the quality, of native produce should, in the course of time, help to improve the present poor reputation of Fiji's product.

In addition to the actual improvement of the quality of native copra there are several other aspects which affect marketing which are worthy of consideration.

Firstly, before any lasting improvment can be made in the standard of Fiji copra, it would appear essential that the trade in " green copra," whether by licensed or unlicensed dealers, should be prohibited.

There are many planters in the Colony who produce excellent quality copra, either sundried or kiln dried, but who frequently, particularly in the case of the small planters, do not receive any monetary inducement for making a superior grade. This is, seemingly, often due to depreciation of good copra by the admixture with it of inferior produce in an effort to improve the marketing chances of the inferior article. In many districts this bad copra used for mixing with the better quality copra is derived from " green copra " sold by Fijians to the local storekeeper, who may or may not be licensed—most of them are unlicensed. The storekeepers, either Chinese or Indians, dry the " green copra " on their own sun drying platforms (" vatas ") which are often unprotected from rains or poultry, to produce what can generally be classed as poor copra and which is usually misnamed " native copra." Admittedly some buyers of " green copra " make good quality copra but unfortunately in most cases the standard is very low. Sometimes the " green copra " is only left on the " vatas " for one and half or two days when it is removed to make room for more " green copra " and the curing is finished off by mixing it with dry copra in the copra store, which is contrary to Regulations.

Such copra is usually affected with moulds, bacterial sliming and insects. In many cases the "green copra" after arrival at the storekeepers' "vatas," is left in sacks for at least twenty-four hours and often for several days before any drying is done and hence bacterial action has already set in before any drying of the meat has been possible with a consequent reduction in the quality of copra. It is generally recognised that copra prepared in this manner is mainly responsible for the high fatty acid content of so called native copra, which gives the South Seas' product a bad reputation.

Also, much of the Fijians' "green copra" is dried by the shopkeepers by very primitive methods, using "vatas" of poor construction and often of dirty materials. Frequently, the drying is even done on the ground without protection from poultry, dogs, and other domestic animals.

Apart from the poor quality of the copra produced, the Fijian, except near the larger towns, rarely obtains good value for his product from the storekeeper, so that in reality he loses a considerable sum of money annually by the sale of his "green copra." Frequently also the green copra is sold by barter at rates even more unsatisfactory than common cash payments.

Moreover, in addition to the better remuneration the natives would receive for the dried product as compared with the sale of "green copra" the business of drying their own copra should prove a useful occupation of moral value to the Fijian who should be encouraged to do his own work.

Though there are only known to be five "green copra" buying licences, it is well known that practically all small storekeepers, in coconut producing areas, buy this product contrary to the provisions of the copra ordinance, which it is hoped will be more vigorously maintained in the future.

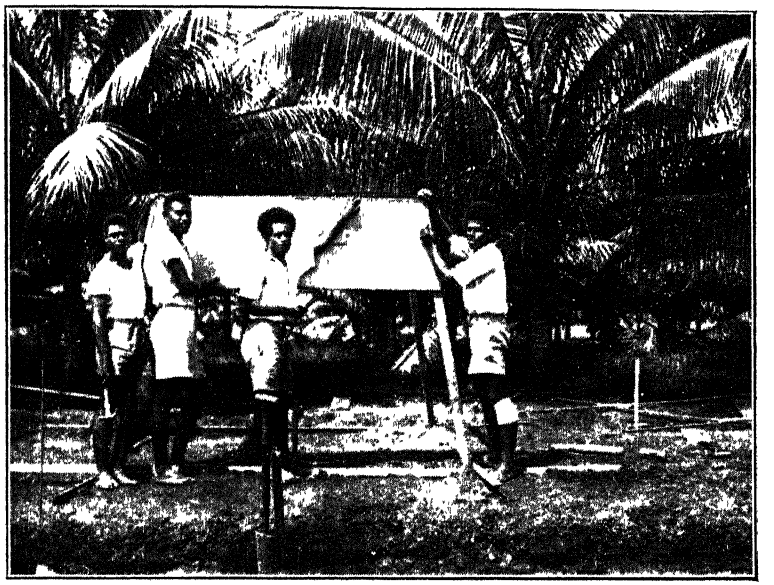
Measures to eliminate or reduce the trade in "green copra" might cause a temporary drop in the output of native copra but this would soon be remedied by the Fijians once they became accustomed to curing their own copra when the better values realised would tend to encourage further plantings and the maintenance of their coconut groves in better condition.

Whole nuts are also often bartered to Chinese storekeepers for goods but the natives rarely receive fair values by this method of disposal of their crops and therefore, it is not in the best interests of the Fijians, who should be encouraged to make their own copra and receive the maximum returns from their plantations and their labours by the use of small driers which they can erect at little cost and operate with ease. Possibly this object could best be attained by provisions in the native regulations forbidding the sale, barter or exchange of nuts or the sale of "green copra" and this matter is under discussion.

Furthermore, more incentive is required to induce planters and natives to produce a better quality of copra than exists at present when large quantities of inferior copra frequently command better prices locally than small parcels of better quality. At present the local merchants have assisted materially by offering a premium of 10s. per ton over local prices for good quality kiln dried native copra and while this is a distinct move in the right direction it is unlikely fully to achieve the main objective of better prices in the world's markets and a better reputation for Fijian copra.

The existing divergence in prices paid on the London market for Fijian (South Seas), Rabaul, Malayan and Ceylon copra clearly indicates that there is room for much improvement locally. For instance, since January, 1934, South Seas copra in London has yielded returns per ton approximately averaging 14 shillings less than Rabaul copra, 22 shillings less than Malayan

SMALL COPRA KILNS UNDER CONSTRUCTION BY FIJIANS AT THE CENTRAL AGRICULTURAL STATION.



EARLY STAGE.

COMPLETE KILN - WITHOUT "MBURE."

copra, and 40 shillings less than Ceylon copra. Thus, South Seas copra is definitely inferior, chiefly because its manufacture is mainly dependent on uncertain weather conditions and because of the habit of dealing in "green copra." There is no reason why Fijian copra should not equal the Rabaul product in London prices or even the Malayan product, with considerable financial benefit to the Colony since if our product was awarded prices equal to those of Rabaul the financial increase to the Colony would approximate £21,000 annually on an output of 30,000 tons (34,500 tons in 1936.) In New Guinea it is claimed that the increased return due to the grading of copra in the last three years has exceeded £15,000 per annum and it is believed that proportionate increases could be obtained locally by the adoption of some form of compulsory grading akin to that in use in Rabaul.

Naturally, general improvement in grade is fraught with many difficulties, but similar difficulties, economic and temperamental, have been overcome in other countries and the present apparent and welcome desire of the Fijians for improved economic conditions should assist in making gradual improvement in the right direction. The majority of the larger planters have already indicated whole-hearted support for any practical measures that can be adopted for the general improvement of our product and would undoubtedly co-operate in any such important movement but the first step is the early suppression of the custom of selling "green copra" to immigrant shopkeepers and the extension of instruction in the preparation of good copra is desirable.

In connection with the copra industry it is necessary to bear in mind that a time may come when inferior copra will not be marketable in competition with copra of better quality and with other interchangeable oils and oil seeds. Also, that the lower the prices for ordianry copra, the wider does the divergence in prices between good and bad copra tend to become except when exceptional conditions exist.

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CORRIGENDUM.

In connection with the article on "Small Copra Driers" which appeared in Volume 8, No. 2, of this *Journal*, the top line of page 10 should read: "(7 a.m.). If dull or wet weather prevails, light at one end, a single . . . . . "

## AGRICULTURAL DEMONSTRATION STATIONS.

By
B. E. V. PARHAM, M.A.,
Agricultural Officer (Pathology).

DURING recent years it has become increasingly obvious that native agriculture in Fiji has developed a trend towards individualism and independence of effort and whatever the underlying causes of this development may be, it has brought its own particular problems, not only of ways and means but also of methods.

The Field Division of the Department of Agriculture has been actively engaged in the study of these problems for the last few years and has given much assistance by means of advances for the purchase of stock and implements, by marketing of crops grown, by technical advice, by the training of youths in agricultural methods and by the organisation of agricultural schemes for selected men.

Ways and means have not been wanting and in all Provinces there has been an increase in the number of Fijians seeking to devote their whole time to agricultural pursuits on an independent basis and much good work has been accomplished.

Apart, however, from the immediate problems of land tenure, exemption from communal services and the maintenance of ahousehold apart from the village, there are the major problems of efficient land utilization, soil conservation and the substitution of permanent occupation combined with intensive cultivation for the wasteful methods of shifting cultivation and its accompanying evils of dissipated energy, soil erosion and improvement and the difficulties of transport and marketing.

With a view to giving the utmost practical assistance to native cultivators by the dissemination of information and by actual examples of improved methods of soil utilization, Demonstration Stations or Agricultural Substations have been established in several Provinces during the past two years at the instigation of the Director of Agriculture.

The aims of these areas have been to afford occular demonstration of the advantages to be derived from intensive cultivation of a diversity of crops and to stresss the imprtance of the conservation of soil fertility by the use of farmyard manures, rotations, regeneration by green manures, the prevention of waste by use of composts and soil conservation by means of contour planting, terracing, cover-cropping and other methods of preventing erosion on sloping land.

The Demonstration Station is, in a word, a model small-holding worked by a Fijian Field Assistant on a rotational system with crops suited to the particular locality and people.

For example, the Nanduna Demonstration Station on the Waindina River consists of five series of plots under various food, cash and green manure crops with bananas as the main crop; and of one series of permanent crops including citrus, derris, pineapples, annatto, coffee, arecanuts, tea, &c.

The area has been specially selected on a rural thoroughfare and is accessible to all Fijians in the neighbouring districts of Waindina, Viria and Navuakethe and comprises both flat anal and hill-slopes typical of the soil normally cultivated in the Province.

The total area of 15 acres is somewhat larger than that considered possible for one man to manage but this is due to its utilization for trial plantings of useful native and exotic forest trees of which ten species have been established and for field experimental purposes in connection with Departmental projects.

The area has been managed since its inception by a Native Field Assistant of the Department who lives on the area and is available to advise and assist native cultivators in the vicinity with regard to the planting and marketing of crops, &c.

The staion also serves as a seed distributing centre for the surrounding districts and as an information bureau on native agricultural matters, and during 1936 crops of bananas, kumalas, rice, soya bean, maize, ndalo, tapioca yams and ginger were harvested.

During the first working year, the revenue derived from this station amounted to £20 5s. 0d., being made up of sales of produce as follows:— Ndalo £8 16s. 0d., tapioca £8 10s. 0d., kumalas £1 19s. 0d., yams and maize £1.

A solidly constructed building, 24 x 18 feet, having thatched sides and a corrugated iron roof was built to house the Native Assistant and two Fijian student workers at a cost of £39 and it is a credit to their workmanship.

The Field Assistant in charge during 1936 was Meli Rokobici who carried out his duties with ability and in addition he had charge of the adjacent Fijian peasant settlement

This settlement comprises ten native farmers, each with an area of approximately ten acres. These holdings are being worked on a rotational system similar to that of the Demonstration area but with somewhat larger more economic individual unit areas for the various crops.

Each settler lives on his own block of land, rented from the Crown, and has built his own house. Already 15 acres of the settlement have been planted with such crops as bananas, ndalo, yams, tapioca, coconuts, ginger, pine-apples and tobacco whilst rice will shortly be planted on several cleared acres.

These settlers during 1936 exported 348 cases and 309 bunches of bananas, these exports alone relaising £90 7s. 6d., whilst they also marketed ndalo, yams, tapioca and kumalas.

In the early stages the settlers were assisted financially by wages received for work as banana selectors and punt men for Canada banana shipments and for work on the adjacent Demonstration Station. They were further assisted by an advance of £2 worth of planting material and of £4 for purchase of implements.

Exemption from communal duties has been obtained for these settlers who appear to be adjusting themselves readily to the land as independent peasant farmers. Normal precautions are being taken to assure generally satisfactory sanitary measures at this Settlement and every assistance is being given in the matter of marketing produce.

This brief notes serves to show how the adoption of Demonstration Stations aims at the assistance of Fijian Agriculturists by supplying planting material, by collecting produce for marketing, by affording an occular example of what can be done in the way of soil management, by making advice readily available to them through the Fijian Assistant in charge, and by acting as an incentive to cultivators in the vicinity.

The settlers living adjacent to the Demonstration Station appear to be happy and contended and should ultimately prove excellent citizens as settled individual peasant farmers.

The Fijian settlers are fast gaining confidence in the efforts of the Department to better their conditions and the close contact afforded by the constant supervision given to the settlement is strengthening that confidence which should augment progress and contentment.

Since the establishment of the Demonstration Station the number of independent cultivators in the three adjoining districts has doubled and most of these men have not only undertaken the cultivation of a greater variety of crops but have also much improved their methods and the general lay-out of their holdings.

The importance of adequate housing and sanitary arrangements is stressed by example and has had a good effect.

The utilization of efficient tools and implements has also enabled individuals to cultivate and tend larger areas than before; and to give better attention to drainage, &c.

The demands for assistance with planting material, implements and advice has grown proportionately as the ideas involved have made their impression on the minds of the more enlightened men living within reach of the area. It is realized however, that the scheme is still in an experimental stage and that the problems, in their associations with native administration, land tenure and soil erosion, &c., justify, as they demand, much more experimental investigational work than has yet been possible

In this connection the following quotation from the Empire Journal of Experimental Agriculture is significant. Dealing with the " Introduction of Mixed Farming in Northern Nigeria," Faulkner and Mackie, after describ-

In this connection the following quotation from the *Empire Journal of Experimental Agriculture* is significant. Dealing with the " Introduction of Mixed Farming in Northern Nigeria," Faulkner and Mackie, after describing initial failure, state that:—

> "At the outset, therefore, of our renewed efforts the agricultural officers, plant breeders and chemists were constituted into a team of experimenters with instructions to investigate every aspect of the subject—their objective was to evolve a system of which every detail had been tested in field trials and experiments. Subsequent events have proved the wisdom of this procedure; and it is also found that the greater the progress we make in our extension work the more important the experimental work becomes. For now we have gained the confidence of the farmers we can less than ever afford to give any advice by precept or example, which is not based on certain knowledge."

With the recognition of these principles, it is possible to look forward with confidence to the increasing utility and value of the Demonstration Station as a dynamic force in establishing and maintaining a prosperous independent native peasantry in Fiji— and thus provide a practical solution to the ploblems araisng out of the slow but inevitable breaking-down of the communal system.

# THE LIME REQUIREMENT OF FIJIAN SOILS.

By

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IN an article in the *Fiji Agricultural Journal* (Vol. 8, No. 2, 1936) a general account was given of the advantages to be secured by maintaining a proper lime status in the soil. Observations were recorded also on the acidity of Fijian soils and attempts made at Navuso with coral sand, to secure an optimum soil environment.

In the course of soil survey work carried out in Tailevu, Navua, Koro and portions of Vanualevu, many determinations of the acid status of our soils have been made and in a few selected cases the lime requirement of the soil as determined by chemical methods has been secured.

In the following table the soils so far examined are grouped according to their pH. values:—

TABLE 1.

| Locality. | Type. | pH. (Soil). | pH.(Subsoil) | Comments. |
|---|---|---|---|---|
| Tailevu .. | Characteristic alluvial .. | 5·32 to 5·98 | 5·76 to 6·36 | Higher subsoil pH. |
| Tailevu .. | Lighter coloured alluvials . | 4·45 to 5·11 | 4·77 to 5·47 | Impeded drainage. Higher subsoil pH. |
| Tailevu .. | Red soils reed covered (Tuff) | 4·41 to 4·91 | 4·36 to 4·65 | Lower subsoil pH. |
| Tailevu .. | Yellow red (residual andesitic). | 4·30 to 4·84 | 4·74 to 5·55 | |
| Tailevu .. | Red Yellow (residual basaltic). | 5·79 | 7·12 | Much higher subsoil pH. |
| Suva Princess Road. | Residual Marl Soils (old forest). | 4·67 to 5·15 | 4·83 to 4·90 | |
| Navuso .. | Lower Rewa alluvials .. | 4·66 to 5·36 | 4·91 to 5·77 | |
| Koro .. .. | Deep alluvials .. .. | 6·29 to 6·61 | 6·04 to 6·97 | pH. increases with depth to 4 feet. |
| Koro .. .. | Residual volcanic soils (Basalt ?) | 6·46 to 7·67 | ... | Submitted by D. of A. no subsoils taken. |
| Malau . .. | Alluvial flats .. .. | 5·15 to 5·28 | ... | Submitted by D. of A. no subsoils taken. |
| Malau . .. | Residual volcanic (Malau) . | 7·82 | ... | Submitted by D. of A. no subsoils taken. |

The table indicates that, with the exception of the basaltic soils of Koro and Malau, most of our soils are on the acid side and that extreme acid conditions, indicated by pH. values lower than 5, exist in many localities. Also it will be observed that, with the exception of a single basaltic soil from Tailevu, there is little difference in pH. between the surface and subsoil, to a depth of two feet. This point is more clearly indicated in table 2, which depicts the pH. values of soils from sleected profiles.

TABLE 2.

| Profile locality. | Type. | pH. 1st foot | pH. 2nd foot | pH. 3rd foot | pH. 4th foot | pH. 5th foot |
|---|---|---|---|---|---|---|
| Wainivesi, Tailevu Series | Tuff with scrub | 5·60 | 5·60 | 5·69 | 5·55 | .. |
| Princess Road, Suva Series | Marl. low fern . | 5·15 | 4·90 | 4·76 | 4·69 | .. |
| Princess Road, Suva Series | Marl. low scrub | 4·67 | 4·83 | 4·70 | 4·80 | 4·76 |

It is apparent that there is little change in acidic conditions to a depth of four feet and that deep cultivation such as subsoil ploughing will not rectify surface conditions.

The hydrogen ion concentration of the soil or pH. as it is conveniently described) has qualitative significance only in deciding the lime requirement of a soil. If the lime demand has been determined for a soil type either by field trial or laboratory methods then the pH. value may have quantitative significance for that type. Usually however, the pH. value which is readily determined with extreme accuracy by electrometric methods simply indicates that acid conditions exist and it is necessary in deciding upon the lime dressing required to make direct experiment.

Where experimental stations or demonstration plots are available the lime requirement can be determined by normal field experimentation. These field trials, however, take time to produce results. For advisory purposes therefore, several laboratory methods have been developed.

In this paper the results obtained with three such laboratory methods are described.

PERCIVAL'S METHOD.

(*Soil Science*, 1931, Vol. 32, pp. 459 to 465.)

In this method several lots of 60 grams of soil, air dried and crushed to pass through 1mm. sieve, are mixed with 0·06 to 0·48 grams of pure calcium carbonate corresponding to dressings of 1 to 8 tons per acre of the carbonate. After the addition of 60 ccs. of water to each sample the material is placed in separating funnels and air aspirated through the whole series for 20 hours. The pH. values are then determined and the results plotted against the amount of CaCO3 added. The amount of CaCO3 required to produce pH. 7, is interpolated from the graph.

PRESCOTT'S AND STEPHEN'S METHOD.

(*Journal Australian Council of Scientific and Industrial Research*, Vol. 7, No. 4, 1934.)

This is a modified Veitch method and consists in evaporating to dryness on the water bath several 30 gram lots of air dried soil charged with varying quantities of saturated lime water corresponding to definite field dressings. One portion is evaporated with distilled water alone. After drying during which the material is thoroughly stirred the soil is well mixed and ground to pass a 1 mm. sieve. The pH. values are then determined and the values obtained graphed against the corresponding quantities of calcium carbonate in the form of saturated lime water used. By interpolation to pH. 7, the corresponding quantity of calcium carbonate required can be inferred from the graph.

HUTCHINSON AND MACLENNON METHOD.

(*Chemical News*, Vol. 110, P. 61–62, 1914.)

Ten to twenty grams of soil are shaken with 0·02 normal Calcium-bi-carbonate solution for three hours in a litre bottle attached to an end-over-end shaker, the air being displaced with CO2 to prevent precipitation of CaCO3. The filtered solution is titrated with 0·1 normal hydrochloric acid and the amount of calcium carbonate absorbed determined by comparison with the titration value of the original calcium-bi-carbonate solution.

In table 3 there is recorded the comparison between an alluvial soil from Waindoi using the Percival and Prescott methods. The values obtained for a Tailevu soil of similar type to the Waindoi alluvial using the Prescott method is also recorded.

TABLE 3.

| Soil No. | Method. | pH. | pH. 1. | pH. 2. | pH. 4. | pH. 5. | pH. 6. | pH. 8. |
|---|---|---|---|---|---|---|---|---|
| Waindoi 103 | Percival | 4·77 | 4·98 | 5·25 | 6·09 | 6·22 | .. | 7·24 |
| Waindoi 103 | Prescott | 4·77 | 5·03 | 5·07 | 5·74 | .. | 6·31 | 6·63 |
| Tailevu 134 | Prescott | 5·23 | 5·89 | 6·17 | 6·83 | .. | 7·26 | 7·60 |

In the Table pH. 1, &c., refers to pH. values determined after addition of 1, 2, &c., tons of lime as CaC03 per acre of 2 x 106 lb of soil.

These results, when graphed and the values of the dressings interpolated at pH. 7, indicate a lime requirement of 7·2 tons per acre for soil 103, by Percival method and 7·8 tons per acre for soil No. 103 by Prescott's method. Fair agreement exists between the Prescott and Percival methods on soil 103, and it will be noted that the lime requirement of the Tailevu alluvials is somewhat lower than that of the Waindoi alluvials, the Tailevu soil by Prescotts method requiring only 4·4 tons per acre.

The Hutchinson and MacLennon method has been much criticised by various workers and although it may not have the precision of the Prescott and Percival methods and although its indication may vary somewhat with the quantity of soil used it is certainly a very rapid method and requires little attention. Moreover the opinion is expressed that the method if properly standardised is of distinct value in soil survey studies and that its indication, although a minimum as far as Fiji soils are concerned, has greater precision than pH. values. In table 4 are grouped a number of soils whose lime requirements have been determined by the Hutchinson and MacLennon method.

TABLE 4.

| Soil No. | Locality. | Lime requirement. | Soil type. |
|---|---|---|---|
| 122 | Tailevu .. .. | 3·1 tons per acre | Alluvial. |
| 103 | Waindoi . .. | 5·9 „ „ | Alluvial. |
| 111 | Malau .. .. | 2·5 „ „ | Alluvial |
| 134 | Tailevu .. .. | 4·4 „ „ | Alluvial. |
| 3 | Lauthala .. | 2·0 „ „ | Coastal soil. |
| 6 | Nasinu Exp. St. | 5·6 „ „ | Marl (Lateritic). |
| 8 | Fiji Club .. | 7·3 „ „ | Marl (Lateritic). |

The lime requirement in this table is expressed as tons of calcium carbonate required by an acre of soil of 2 x $10^6$ lb.

In comparing the Prescott method and the Hutchinson and MacLennon method on soils No. 103, and No. 134, it will be observed that the agreement is only fair in the case of soil 103, but excellent with soil 134. It will also be noted that that there is little correlation with pH.

The above figures further emphasise the lime requirement of the soils referred to in previous papers. Under present conditions the requirements for neutrality are very large particularly when it is realised that in some cases the real lime demand may be 100 per cent. greater than that recorded in laboratory experiments.

The lime status of the soil should be adjusted to the lime requirement of the crop and it is very seldom that soils require to be limed to complete neutrality from this point of view. As far as Fiji crops are concerned it would appear that pH. values from 6 to 6·5 necessitating lime dressings between 2 to 5 tons to the acre are required for citrus, banana, and sugar. For other minor crops and for pastures the economic return would not warrant the outlay, although light annual dressings from half to one ton per acre would benefit pineapples grown on the red soils and would probably show an economic return. As far as Fiji pastures are concerned it is considered that, until cheap lime can be obtained in quantity, it would be uneconomic to introduce a liming programme.

SUMMARY.

(1) The pH. status or intensity of acidity of several Fiji soil types is recorded.

(2) Profile pH. distribution of certain soil types susceptible of cultivation show acid condition up to four feet with little variation in pH. with depth.

(3) The acidity as determined by pH. values is correlated qualitatively with a lime demand.

(4) The lime demand as indicated by Laboratory methods recorded above show requirements varying from two to 7·4 ton per acre of $2 \times 10^6$ lb.

(5) Three methods of determining lime demand on a typical alluvial are compared and it is considered that although the Prescott and Percival methods have a sounder theoretical basis than the Hutchinson and MacLennon method, the latter if used intelligently, and under standardised conditions, can yield useful results particularly in soil surveys.

It is considered that until cheap supplies of lime are rendered available it would be uneconomic to lime for pastures or minor crops.

# THE BIOLOGICAL CONTROL OF THE WEED CLIDEMIA HIRTA, COMMONLY KNOWN IN FIJI AS " THE CURSE."

By

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Government Entomologist.

## INTRODUCTION.

THE history of the introduction and spread of the melostomaceus plant, *Clidemia hirta*, has, so far as the writer has been able to ascertain the facts, already been fully described and a number of reports issued upon the success which has attended the efforts to bring it under control by biological methods (*a—b—c—d—e—f—g—*). In consequence, the time now seems ripe to review the whole position briefly and to summarise the present state of affairs.

## HISTORY OF WEED IN FIJI.

Briefly the plant is supposed to have been accidentally introduced into the Waimanu District of Fiji with coffee plants from Brazil, and certain slight distinctions between the British Guiana, Trinidad and Panama forms of the plant, observed by the writer when carrying out his investigation in those countries, support the view that it came from the mainland of South America. The writer has been unable to ascertain the exact date of the introduction, but it was probably between 1880 and 1886. The plant first began to appear as a low hedge along the wire fences (where the seeds had been dropped by birds) and spread with such alarming rapidity as to acquire the title of the " Curse." It invaded the meadow lands, where cattle would not touch it, and soon covered wide areas to the exclusion of all other vegetation, forming a dense matted growth, four to six feet high, through which the cattle were only able to keep open narrow tracks. It was almost equally at home in such permanenet plantations as rubber and coconuts and even invaded the dense native bush. So grave did the position become and so hopeless the task of keeping it in check by hand, that it was even proposed to offer a reward of £5,000 to anyone who would evolve a method of combatting it, an offer which was actually made for the control of another pest at that time, *Levuana iridescens*, the purple Coconut moth.

When C. H. Knowles was appointed in charge of the Department of Agriculture, he took the matter in hand and when the writer joined in 1919, had already located the home of the weed as Central or South America.

In that year reports were received that the plant had had a check in a part of the Waimanu district and the writer was detailed in November 1919 to investigate this check, which, incidentally, proved to be due to nematode worms.

Following on this work the writer forwarded pressed specimens of the plant and paintings of the flowers and seeds to the various Departments of Agriculture in Central America, and to the West Indies, hoping to ascertain the presence of any insect agency likely to assist in checking its ravages. Arising out of these inquiries, Urich of Trinidad discovered the thrips, which now bears his name, *Liothrips urichi*. He did not, however, place any very high value upon it as a control, and the matter rested for some time.

In 1927 T. H. C. Taylor, who was visiting Trinidad in connection with coconut scale control was instructed to investigate the matter further, and, as a result of this preliminary inquiry, reported favourably upon the action of the insect.

It was then decided to test the insect for undesirable habits, a local student, Cook, *k.* being detailed for the work. This officer found no bad habits, but expressed a somewhat pessimistic view as to the value of the insect as a control. In view, however, of the seriousness of the weed it was decided that the introduction should be attempted, the writer being instructed to carry out the work, which was commenced in October, 1929. When doing this two important points came out.

(1) That the Thrips was itself in Trinidad subject to heavy pressure from a number of previously unsuspected enemies, the elimination of which would enormously increase its efficiency.

(2) That the weed also had many other insect enemies in addition to the Thrips, these being chiefly seed destroyers. So that in the event of the Thrips proving insufficient, further biological pressure was possible.

The introduction of *Liothrips urichi* into Fiji was successfully accomplished in March 1930, and results have shown that the work of screening out its own enemies was completely performed.

The first releases were made at Lami and Nasinu in large solid areas of the weed, and for a little over a year no apparent progress was made. This was partly due to the unfavourable dry weather, but, no doubt, scattering has much to do with the apparent failure of the insect to make headway. This scattering, however, led to the formation of numerous small foci and with the return of normal conditions and suculent growth, the insect began to increase with astounding rapidity, crossing wide areas of sea and jungle (as much as 30 miles of open sea) and everywhere by its attacks on the terminal shoots stunting the weed, which then became overgrown and strangled by competing vegetation. The general effect was that by 1934 large ares of what had been dense curse had been replaced by a mixed growth, much of which was useful vegetation.

There still remained, however, considerable areas of the pest in certain very wet districts, such as Tholo-i-Suva, near Suva, the Tailevu and Salia Levu in Taveuni, and it was not until 1936 when the dry season was again exceptionally sunny and dry that the insect was able to make great headway in these areas, at least in the two former, although even in the Tailevu, where the dairy settlers regularly cut the plant the pressure of the Thrips upon the young growth had been sufficient to reduce weeding costs to one quarter.

With the dry season of 1936, however, the pressure of the insect upon the plant in these districts became so severe that at Tholo-i-Suva the competing vegetation was able completely to suppress the big area of old weed and to-day only isolated heavily attacked bushes remain in that district, whilst in the Tailevu the vast sea of *Clidemia* at the end of the settlement is now overgrown, and three quarters dead with good grass opening up in patches. In this area one farmer reported that a hill, which formerly cost him ten pounds a year for clearing had cost him nothing for the past two years.

### REPLACEMENT.

In most places the weed has been replaced with useful grasses, para, &c., sensitive and Desmodium. At one place a good deal of Blue rat-tail was noticed, whilst at another *Urena Lobata*, another weed, was in evidence.

### DETAILS NEAR SUVA.

*Navua Road.*—The big area below the old hospital is, except in one small corner, entirely replaced with para grass and Mimosa (sensitive plant).

From here to Lami old paddock it has quite gone. Lami old paddock was until recently solid curse, but this is now replaced with a mixed growth of Mimosa, Desmodium and grasses.

From this point out to about ten miles, the weed has gone, but from ten miles on reappears as isolated heavily attached bushes.

The sward of young seedlings on the clay road and drain facings at Lami and Visari has quite disappeared.

*Princess Road.*—From Suva to six mile, the weed has gone. At six mile the big solid areas on both sides of the road have been replaced with mixed vegetation which in turn is now being brought under cultivation. Isolated bushes show up from the sixth to eighth miles, where the big solid area which formerly existed has been entirely replaced by para grass and a mixed growth of fern. Opposite Sawani, where the owner cut the plant some two years ago, only a few dwarf isolated seedlings have come up.

*Rewa Road.*—The weed has gone from most of this area including the solid patches at Samambula and Nasinu.

*Tailevu.*—From the Rewa to the commencement of the dairy settlement the weed has almost entirely disappeared from the road side, the few plants seen being overgrown and dead or dying. At the end of the settlement the big solid area is now overgrown and largely dead, whilst it is opening out in many places into grassy clearings. On the Wainavesi road and at one other place there was a good deal of the weed in two or three paddocks. Inquiry elicited the fact that these areas were heavily stocked, so that competing vegetation had no chance.

### FOREST CONDITIONS.

The dense shade of the forests, whilst not highly favourable to the pest, is less so to the thrips, and a good many weedy plants are to be seen. Such, however, yield few seeds and are of no economic importance.

### SUMMARY OF POSITION TO DATE.

The thrips can now be said to have accomplished its task. The plant is no longer a Curse; hardly a weed, since it is now unable to compete successfully with the other vegetation. The writer is of opinion that a fluctuating balance can now be said to have been established over most of the infected area, isolated bushes sufficient to maintain a thrips population remaining, the number of such varying from year to year. There still remain a few, three quarter dead, stands of the weed. Such remaining areas have yet to be replaced with mixed growth, but the change is taking place rapidly and can always be hastened by cutting. These areas, however, being mostly somewhat unfavourable to the thrips are likely to support a larger normal curse population than most portions of the country.

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## YANGGARA.

By

H. M. STUCHBERY, B.V.Sc.,
Veterinary Officer.

How many people in Fiji realize as they sit in their comfortable seats at the "talkies" and watch with varying degrees of envy the full-blooded pictures of ranch life in America or station work in Australia, that there is similar life and work in reality almost at their own back door.

In particular Yanggara, the Colonial Sugar Refining Company's cattle and horse breeding establishment, typifies such life. Here, the visitor may see the varied phases of the stockman's work. Be he vocally proud of his horsemanship, he will be given a mount that may test his riding ability and disaster looms ahead if he has over-estimated such ability. Others like the writer, who modestly aver that they do not usually fall off unless the animal breaks too sharply into a walk, will be given an amiable steed that will ensure a safe if somewhat unexciting journey. He may even be honoured with "Taniela," a sagacious animal who although bereft of one eye can detect the shady side of a tree before its seed progenitor has even germinated; or "Mary" a masquerading gelding of aldermanic proportions.

A ride into one of the back paddocks during muster time will generally convince any discontented individual to continue in his chosen avocation rather than become a "cowboy." Always amongst these mobs are the "irreconcilables" who choose every opportunity to "break back" from the others. After them go the horsemen up and down hills of very steep grade till they get them back or lose them in the dense areas of scrub.

Work in the yards is varied and exciting during muster. Branding and castrating young stock, cutting out strays that have got into the wrong mob, with an occasional rebel animal all add to the variety.

Yanggara breed Hereford cattle for beef purposes for the Rarawai and Lautoka butcheries, light horses for supply to the various overseers and others employed by the company who require hacks, and draught horses for the various mills and their tenant farmers when the Company's need have been supplied.

The property is situated at the borders of Ra and Tholo North, some of the property lying in each province. For the greater part the land is devoid of natural trees but along the creeks good shelter trees occur, whilst the gullies and steeper hillsides in the back paddocks are often covered with dense undergrowth and small trees. Shelter trees in considerable numbers have been planted and are still being planted. The property is excellently watered with permanent running streams in all grazing paddocks. The rainfall is between 60–70 inches per annum, most of which falls during the summer months. During the winter months the property is occasionally subject to dry periods, during which anxiety is sometimes caused through comparative scarcity of food, but usually the place carries the stock (about 3,000 cattle and 600 horses) on it quite comfortably.

The breed of cattle decided upon by the Colonial Sugar Refining Company when they first took over Yanggara, was the Hereford. With that end in view Hereford bulls were imported firstly about 1927 also a few Hereford cows. Most of the cattle on the property at the time were mixed breed. From these cows and the Hereford bulls, supplemented at regular intervals by further imported Hereford bulls, a breed of cattle has been evolved which

are at present day showing only the Hereford characteristics. Difficulties were at first encountered in developing the type most suited to Fiji. This breed is peculiarly susceptible to eye trouble in Fiji, the most common of which are epithelimona or cancer of the eye, conjunctivities and keretitis, both of contagious origin and due to injuries which cause inflamation of the eyelids and surrounding tissue due to irritation. It is undoubted that the absence of pigment in the hair and skin around the eye is conducive to such conditions and the ultimate aim of the Company is to produce stock with a fair amount of pigmented hair and skin around the eye and thereby to increase the resistance to disease conditions. The breed otherwise are very hardy and eminently suitable for the purpose required.

Breeding is carried out on scientific lines, always with the view ahead of improving the quality of the herd. Each year the worst of the breeders are culled and speyed and replaced by the best of the young cattle developing into maturity. Good looking breeders too are culled if they are not producing calves up to standard. Only the best of the bulls are used for those breeding cattle from which the future breeding heifers are to be chosen.

The same thoroughness is maintained with the breeding of draught horses. The breed originally chosen as suitable for Fiji was the Suffolk Punch, a wise selection as these animals, although very weighty, are clean legged and not subject to as many foot and leg complaints as are the more hairy legged horses, as the Clydesdale and Shire horses, when they are called on to constantly perform work in wet areas. Moreover they are an active type of horse particularly suited for cane cultivation work. Many fine types of horse of this breed have been produced on Yanggara and they are eagerly sought for by tenants when available. Later, it was decided to try the Percheron breed, a similar type of animal, with equally gratifying results as to the quality of the offspring. Great care is also taken in the selection of young mares to replace old breeders or breeders not up to standard, so that the quality of the young horses bred on Yanggara is constantly improving. Those mares not required for breeding purposes and also the colts, after castration, are sold between the ages of three and four years for working purposes. It was noted that in one paddock there were over eighty 3-year old geldings of Suffolk Punch and Percheron breed. It is doubted if any establishment in Australasia could boast of an equal number of 3-year old geldings of these breeds. Imported sires are regularly used for breeding purposes whilst four Percheron mares have recently been bought in Australia with a view to improving the breed still more.

For the hacks, a thoroughbred sire is used and there are many useful and fine looking light horses bred on the property.

The quality of the soil varies considerably, some of the flat land adjacent to the river is of considerable depth and is all highly fertile. The soil of the rising land and hill country varies considerably in depth and from this point of view may be considered as comparatively poor land. Pasture, however, is quite fair on most of this area. Practically all the accessible land has been top-dressed within recent years, principally with superphosphate, with eminently satisfactory results. It is understood that the Colonial Sugar Refining Company have wisely provided for regular future top-dressing. It is apparent that since the application of superphosphate, there has been a notable decrease in " seed grass " in the pasture and a corresponding increase in better class fodder plants, particularly Desmodium.

Considerable effort has been expended in attempts to improve the pasture on the property by the importation of grasses from overseas and the intro-

duction of grasses from other parts of the Colony. It would appear that grasses already established in Fiji have shown up better and form the bulk of the herbage. The following grasses are of common occurrence, sensitive grass, (*Mimosa pudica*) tropical trefoil, (*Desmodium trifolium*) false thurston grass, (*Brachiaria distachia*) Malolo or Nawai grass (*Dichanthim sps.*) Paspalum, (*Paspalum dilitatum*) Love grass, (*Eragrotis pilosa*) and Caboni grass (*Amphilophys glabra*). This latter grass which forms the foundation of the pasture in the Yanggara area gives excellent young growth, but it tends to become rank in the dry season. Some 80 acres of para grass (*Brachiaria mutua*) now occurs on the flats.

Noxious weeds cause considerable worry but their eradication has always been carried out vigorously. Ellington Curse (*Acassia sps.*), a few years ago practically overran the Company's main fattening paddock, but constant work has generally reduced this pest to a point where control is reasonably easy, and has produced an excellent pasture paddock from a previous wilderness. Guava is the next most serious menace but is well controlled.

Yanggara is under the supervision of Mr. Allen, Manager of the Colonial Sugar Refining Company, Rarawai. For a number of years Mr. Victor Clarke has controlled the administration of the property. Recently Mr. Otley has been appointed as resident overseer under the supervision and guidance of Mr. Clarke. The labour is principally supplied by Fijians who do most of the general stock work on the property. These men having usually a liking for this class of work, become fairly efficient and some become quite good horsemen and are not afraid to try conclusions with an unruly young animal. Anyone doubting the capacity of a Fijian to engage earnestly in his work should observe the efficiency displayed by these men at Yanggara.

Thanks are due to the Manager of the Colonial Sugar Refining Company, Rarawai and other officers of the Company who have always given valuable assistance and information at all inspections of the stock and property. The Colonial Sugar Refining Company is to be congratulated on the fact that, whilst they do not profess any great knowledge of grazing and stock raising, they have attained a very high standard of efficiency, in all branches of the industry.

## SOIL NOTES, KORO AND LAU.

By

W. J. BLACKIE, M.Sc., F.N.Z.I.C., A.I.C., Government Chemist.

and

P. L. R. CHARLTON, Assistant to Government Chemist.

SEVERAL soil samples were taken during a visit of the Director of Agriculture to Koro and the Agricultural Officer, Islands, to Northern Lau. These samples were submitted for chemical examination and the results obtained are recorded in Table I.

The following Field notes were recorded.

*Sample* 78.—This sample was taken at Nathamaki, Koro, 100 yards from the shore at an elevation of 20 feet above sea level. The soil was a deep chocolate colour and of good depth and drainage. Erosion was not in evidence.

*Sampe* 79.—This sample was taken at Rickett's Estate, Lola on the island of Koro, 200 yards from the sea on a slope of about 1 in 7 feet. The elevation of this sample was about 30 feet above sea level and the soil was black coloured for a foot in depth followed by several feet of grey stony soil.

*Sample* 80.—This sample was also taken from Nathamaki, Koro, 200 yards from the sea at an elevation of 40 feet. The soil was brown in colour, drainage good, and erosion not in evidence.

*Sample* 81.—This sample was secured at Natamaki, Koro, 400 yards from the coast at an elevation of 60 feet above sea level. The soil was brownish coloured, of good texture and drainage, and no sign of erosion was noted.

*Sample* 85.—This sample was taken at Matuku (Lau) at an elevation of 15 feet. The soil was brownish coloured, of good texture, drainage and depth. The soil was covered with low scrub and was considered to be suitable for cotton, tobacco, kumalas and coconuts. Erosion was not noted.

*Sample* 87.—This sample was also taken at Matuku in the Lau Group at an elevation of 50 feet. Drainage, cover, soil depth and lack of erosion were similar to 85.

*Sample* 82.—This sample was secured from Loma Loma in Lau at an elevation of about 15 feet. The soil is a chocolate brown of great depth and free drainage. It was considered to be suitable for ndalo, cotton and coconuts.

*Sample* 84.—This sample was taken at an elevation of 50 feet, and had similar properties to 82. It was also secured at Loma Loma and was not considered to be suitable for ndalo. Erosion was slight.

TABLE I.

| Soil No. | Locaility. | P.H. | C.S. | F.S. | Silt. | Clay. | Water | $P_2O_5$ | $K_2O$ | $N_2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| (85 | Matuku (Lau) .. | 7·58 | 29·4 | 23·4 | 20·0 | 19·3 | 6·7 | 0·130 | 0·329 | .. |
| (86 | ,, .. | 6·24 | 32·3 | 19·0 | 18·0 | 25·2 | 6·3 | 0·110 | 0·227 | .. |
| (87 | ,, .. | 7·50 | 9·3 | 13·6 | 18·3 | 49·8 | 7·4 | .. | .. | 0·32 |
| (88 | ,, .. | 7·20 | 9·5 | 11·4 | 24·0 | 54·0 | 3·6 | 0·064 | 0·076 | .. |
| 79 | Koro .. .. | 6·46 | 2·2 | 21·9 | 31·3 | 39·5 | 5·5 | 0·100 | 0·075 | 0·117 |
| 80 | ,, .. .. | 6·89 | Nil | 2·7 | 20·0 | 75·1 | 4·2 | 0·244 | 0·099 | 0·176 |
| 81 | ,, .. .. | 7·67 | 3·0 | 8·1 | 57·4 | 27·9 | 4·6 | 0·320 | 0·087 | 0·322 |
| 78 | ,, .. .. | 7·50 | 14·4 | 6·4 | 12·8 | 59·0 | 10·1 | 0·560 | 0·188 | 0·330 |
| (82 | Loma Loma (Lau) | 7·67 | 18·1 | 20·3 | 28·0 | 31·1 | 4·0 | 0·097 | 0·410 | 0·113 |
| (83 | ,, .. | 7·48 | 22·7 | 20·2 | 34·4 | 21·1 | 3·8 | 0·082 | 0·367 | .. |
| 84 | ,, .. | 7·24 | 21·3 | 17·6 | 25·8 | 31·7 | 5·5 | 0·111 | 0·256 | .. |

Bracketed soils indicate soil and subsoil in serial order. Mechanical analyses were carried out by the Robinson Pipitte technique and the particle size is that adopted by the International Socitey of Soil Science. Phosphorus potassium and Nitrogen were determined by normal technique.

OBSERVATIONS ON CHEMICAL AND MECHANICAL ANALYSES.

*Matuku.*—From the table, soil 85, approximates in comparison to a sandy loam with a somewhat heavier subsoil. Potash figures are good but Phosphate is only medium and decreases a little with depth. It would appear to have an ideal texture and good retentive properties. Soil 87 is heavier in texture as indicated by mechanical analysis and corresponds to a medium clay loam. It would appear to have greater retentive powers than (85). As with subsoil (86) the subsoil (88) is somewhat heavier than the soil. The nitrogen content of (87) is excellent.

*Koro.*—Soil (79) is a loamy clay of medium clay content and would appear to possesses a good texture and fair retentive properties. The high silt might occasion some difficulty in working. Phosphate and Potash are only fair and Nitrogen is medium in value. Soil (80) is a heavy clay loam with excellent Phosphate, medium Potash and Nitrogen. Soil (81) is a heavy loam with medium clay. It would probably be difficult to work and possesses high retentive properties. It has excellent Phosphate and Nitrogen, but the Potash is on the low side. Soil (78) is a medium clay loam somewhat lighter than 80 and possesses excellent Phosphate, Potash and Nitrogen values. It appears to be the most fertile of a series of fertile soils.

*Loma Loma Soil.*—These Lauan soils are of good texture, of the type of light loam. They possess similar silt and clay values which might occasion some difficulty in working. The chemical values indicate fertile conditions.

The table indicates that with P.H. values varying from 6·24 to 7·67 the lime status of these soils is extremely good, and in general the chemical and mechanical values are good. The mechanical condition of (85) (79) (81) (82) might lead to difficulty in working, particularly in wet weather. In these soils the silt in relation to clay is equal to or greater than the clay figure. The worst offender is Koro (81) which contains 57·4 per cent. silt and 27.9 per cent. clay. The texture could be improved by green manuring followed by ploughing in to increase the soil colloids.

It is with pleasure that we acknowledge the assistance in the laboratory of Native Assistant Vilitati Vavaitamana.

## THE GIANT TOAD.

By

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Government Entomologist.

As recorded in the last issue of this Journal colonies of this toad (*Bufo marinus*), received from Lautoka, were released in May and June 1936, in Suva, Nasinu and Navuso. These were the progeny of those imported the preceding February from Honolulu and were all small.

On January 31st, 1937, a few tadpoles from these were observed in the stream at the bottom of the author's garden in Suva and within 48 hours these had increased to several thousands.

They were black in colour and exceedingly small, measuring less than 10 mms. Some 1,500 tadpoles were collected and placed in local ponds, rice fields, &c., out as far from Suva as Ra. Of the balance left in the stream all moved down to the small drain which passes through the Cricket Ground whence, on the night of the 8th-9th February, heavy rain floods swept them out to sea. A few kept in the Laboratory for observation developed legs and left the water from the 16th-18th taking about seventeen days only in the tadpole stage.

At Nasinu in the cooler weather of April-May, the Agricultural Officer South (Mr. H. R. Surridge), reported that he observed spawn on a submerged grass bank between two still pools on April 20th. This was in the form of a clear, gelatinous rope about ⅜ inch thick. Tadpoles were observed on the 24th–25th and by May 7th they began, after 14 days, to show their legs, reaching the adult stage and commenced to leave the pool on the 16th.

Several young toads, less than 12mms. in length, black in colour and with minute yellow spots, were released by the stream in the writer's garden on the 18th February and on the 26th March 1937, two about two inches long were observed in the garden, being probably two of these. It will thus be observed that from date of spawning to maturity and the next generation has under Fijian conditions, been not more than eleven months.

The toads spawned again in March, this time lower down in the Cricket ground and were again swept to sea, this time before the writer was aware of their presence. Four other spawnings took place for certain, two at Nasinu and two in the pool at the Botanical Gardens and it is thought that a reasonable proportion of both these reached the stage of leaving the water, several 1–1¼-inch specimens having been observed about the gardens some six or seven weeks after this spawning. Whilst it is unfortunate that the frequent floods at this season made the stream in Suva a somewhat precarious breeding place, the short tadpole stage, seventeen days, should, when the toad population becomes greater, enable many broods to mature between floods.

A mature female toad, run over by a motor-car at Nasinu was examined for its stomach contents. This specimen had full ovaries being just ready to spawn. The stomach contained three slugs, one snail, one centipede, two Rose beetles, three millipedes besides small stones and a few stems of grass. It will thus be realised what a boon this amphibian will be when its numbers become sufficiently great.

It will give some idea of the slug population of Suva, that the writer has been able to destroy nightly, in his garden some 200–300 of these vermin,

and estimates that he has killed between 20,000 and 30,000 in the past five months on about three-quarters of an acre of lawn and garden. So that there is ample room for a consideralbe toad population.

A colony of 50 tadpoles collected in the Botanical Gardens was despatched to Mua, Taveuni on the 15th April, 1937. This being the first batch to be sent to that Island and on May 11th a colony of about 200 tadpoles was forwarded to the island of Rambi.

## THE HAWKBILL TURTLE.

By
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Senior Veterinary Officer.

IT has always been the habit of the hawkbill turtle (*Cheloni imbricata*) to use the island of Makaluva, situated about eight miles east of Suva as a breeding ground. Having in mind therefore the value of the shell which is derived from this turtle an arrangement was made by the Director of Agriculture for initial experiments with a view to the adoption of protective measures for the species.

It is a well known fact that few newly hatched turtles survive the first day of free life owing to the depredations of carnivorous fish and birds. Hence an attempt was made to study the feeding habits, shell changes, &c., by keeping newly hatched turtles of the above variety in captivity until such time as they would, by their increased size and ability to feed, be able to survive.

Mr. Beveridge, caretaker of Makaluva, kindly undertook to supervise the initial trial of caring and feeding the young turtles, with the assistance of the labour available on the island.

Accordingly the young from the hatchings of two lots of eggs were kept confined in a large wooden trough. It was found that the very young turtles were unable to submerge to the bottom in deep water. The depth of the water was therefore lessened and sand was added to the bottom of the trough.

Various forms of seaweed was fed as well as shell fish occasionally. The water was changed twice daily so that the conditions under which the young turtles were kept were good. Nevertheless, they failed to thrive and all except four died.

The cause of death was starvation due to unsuitable diet.

In consequence, twelve young turtles were brought to Suva and kept at the Agricultural Department under conditions not so good as those existing at Makaluva. Of these, four died the day following their arrival at Suva. The remaining eight thrived excellently on a diet of shell fish and beef in about equal proportion and increased their weights by approximately 300 per cent. and in size by about 200 per cent. in two and a half months, when their shells had become tolerably strong and hard.

This preliminary experiment indicates that much could be done to improve the supplies of our turtle shell if young newly hatched turtles could be collected and protected from the natural enemies until their shells were hard enough to afford the natural protection.

## GENERAL NOTES.

### TREE PLANTING.

In connection with a suggestion that the Coronation should be commemorated by the planting of trees and shrubs, it is of general interest to state that on Coronation Day 637 trees and 270 cuttings of ornamental trees were planted by various schools, &c., in the Colony.

The planting materials were supplied by the Department of Agriculture and reports indicate that most of the plantings have "struck" well.

### POINT ROAD.

A programme of tree planting has been started along the Point Road where the high salt water table and the constant strong winds preclude the use of many of our best flowering trees. It is however, hoped that the planting of coconuts and other wind resistant species will in time afford the necessary shelter for the less robust and more showy flowering species. In the meantime it is considered that coconut palms and a small number of Norfolk pines and New Zealand christmas trees will prove attractive to the inhabitants and to visitors to our shores.

In this connection a plea is made to the public to afford these trees every opportunity to thrive well so that they may grow into shapely ornamental trees and so amply repay the cost of planting and maintaining them.

### CATTLE FROM AUSTRALIA—IMPORTATION PROHIBITED.

Owing to the outbreak of a disease known as Three-day sickness or Ephemeral Fever among cattle in Australia, the importation of cattle into Fiji from that country has been temporarily suspended. It is impossible to say how long it will be necessary to keep this embargo on Australian cattle, but stock breeders will realise that the action taken is in the best interests of cattle owners in Fiji. Just as soon as it is considered safe to do so the embargo will be removed.

2. The disease has a low mortality. Not more than three per cent. of affected animals succumb but when newly introduced into a country where cattle have no immunity whatsoever the fever is severe and the great majority of animals contract it.

3. Insects such as mosquitoes are said to be the carriers of the disease which resembles dengue fever of man in many respects.

### CITRUS.

Exports of these fruits to New Zealand were favoured with good prices during the past two months, thanks to a shortage of supplies. For the first time on record, grape fruits were exported to the extent of 110 cases and realised remunerative prices. For an intelligent and painstaking grower it is anticipated that grape fruit will become a profitable export crop in the next few years and the Department of Agriculture is endeavouring to stimulate its culture.

### ANNATTO.

The New Zealand Co-operative Rennet Company at Eltham has under construction a new modern cheese factory costing over £6,000. In this building will be included a laboratory for research into cheese problems including tenner and cheese colouring substances. One of the raw materials used in colouring cheese in annatto and for this product there is a small but constant demand at economic prices.

The plants grow to production in two years with little or no attention, and form useful ornamental hedges. The work required in the collection of the ripening pods, just before they burst, is slow but easy. The pods are then dried and the seed threshed out and cleaned before bagging for export in as fresh a condition as possible.

Efforts are being made to secure this small market in Fiji and those interested should communicate with the Department of Agriculture through their Divisional Agricultural Officers.

### PUBLIC HEALTH REGULATIONS.

The new Public Health Regulations made by the Central Board of Health and published in the *Fiji Royal Gazette* No. 24 of 1937, mark a decided advance in Public Health Administration. The Regulations are now made to apply throughout the Colony whereas previously they only applied to Suva area. The uniformity thus attained should greatly facilitate the administration of the Regulations.

2. The duties of Medical Officer of Health and of Sanitary Inspectors are defined in these regulations. Sections of interest to Agriculturists and animal owners, are those relating to Slaughter Houses and Meat Inspection, Dairies, Tuberculosis in dairy herds and the keeping of animals.

3. The method of slaughtering cattle in slaughter houses provides for the use of humane killers but in certain cases a shot gun may be used.

4. All dairies must now be registered with the Local Authority of the Sanitary district in which the dairy question is situated. Similarly all cattle in registered dairies must now be tuberculin tested at Government expense by a Government Veterinary Officer.

### DESTRUCTION OF THE BED BUG.

A promising advance in solving the problem of the destruction of bed bugs is reported in the *British Medical Journal* of February 27, p. 459, by Messrs. S. A. Ashmore, of the Government Laboratory, and A. W. McKenny Hughes, of the Natural History Museum, acting for the Committee of the Medical Research Council.

The authors put forward a simpler method with which they have had promising results both in the laboratory and in about two hundred infested houses. It consists in spraying the room at a temperature not below 60° F. with a quantity of fairly high boiling coal-tar naphtha for which a specification is given, the room being thereafter sealed for eighteen to twenty-four hours. It is claimed that this substance is not only lethal to the insects, but is also an ovicide and that it is not harmful to other animals. The concentration of vapour necessary is well below that of the flash-point of its mixture with air. Research is going on at the Field Biological Station of the Imperial College of Science to determine which of the many constituents of this coal-tar naphtha is specially efficacious, but the above-quoted report points to a remedy, by the careful use of a cheap and easily obtained product. It is greatly to be hoped that this method proves successful, for this social evil is a very great and widespread one. – (Extract from *Nature*, Vol. 139, No. 3521.)

### BROOM MILLET.

Two varieties, namely, Scarborough Dwarf and White Italian were planted in the nursery in Singatoka in May 1936, from imported seed. Despite very dry conditions during June, July and August some good quality heads were harvested in September. The brush was used in making a number of brooms, both large and small. The handles were made from Fiji Kauri

(Ndakua) and the string used in sewing was made by hand from Hibiscus fibre grown at the Station. The brooms were shown as Departmental Exhibits in the Suva Show in October (1936) and drew favourable comment.

A number of plants of each variety were selfed to provide pure seed for the next planting. In October one row of each variety was planted with acclimatised seed. Excellent germination was obtained and the plants made rapid growth. The first lot of heads were harvested during the middle of December, 67 days after planting. The second lot was harvested two weeks later.

The second sowing from acclimatised seed was made on 15th December. Fair germination was obtained and the young plants are making satisfactory.

It is proposed that when sufficient brush is in stock an attempt will be made to manufacture brooms on the lines of a cottage industry. The brush appears to be of excellent quality and good colour and quite the equal of the imported article. It may be worth while introducing such an industry into the Prisons to provide brooms required by Government Departments, the brush to be grown by the Experiment Station, Provincial Schools and such like.

### ADVANCES TO FIJIAN AGRICULTURISTS.

Under the scheme of agricultural advances to Fijians in the Western Agricultural Division the following list of implements has been issued during the last few years:—

| | | | |
|---|---|---|---|
| Ploughs .. .. | 58 | Harness sets .. | 25 |
| Harrows .. .. | 24 | Bars .. .. | 7 |
| Cultivators . .. | 21 | Bullock chains .. | 10 |
| Disc coulters .. | 19 | | |

Repayments of the amounts represented by these advances are being made at approximately twenty per cent. per annum, which is reasonable.

It may be mentioned that all advances are given in kind (implements,, &c.) and none in cash.

### PULSES.

Three types imported from India all showed rapid growth under Singatoka conditions, recently giving quite satisfactory crops. Selections of the three types have been made for further experiment, some of them showing very good promise as an adjunct to local pulse supplies.

### INDIAN SETTLEMENT AT NDOMBUILEVU.

This Settlement comprises fifty-six men, forty-six women andeig hty-eight children and already one store has been erected in addition to sufficient houses for the various families. The Settlement has the advantage of the presence of one particularly progressive man whose farm has already become a model with well placed drains and a variety of field and garden crops.

The main plantings so far include rice, ndalo, tapioca, mungh, yams, maize, and cotton.

The settlers have made very good progress in a short time in fencing their lands and getting their food crops planted and they are gaining confidence in the Officers of the Department of Agriculture.

### POULTRY.

A rooster and eight hens of the Australorp breed imported during 1936 for the purpose of improving the breeds of local poultry, are breeding well and producing satisfactorily. Already a considerable number of settings have been sold at reasonable prices and distributions have been made to various agricultural stations for multiplication so that the utility of the import is certainly promising.

### TUBERCULIN TESTING.

As a result of the application of the tuberculin test to Suva dairy herds the incidence of tuberculosis in cattle in the Suva area has been reduced from 18 per cent. in 1931 to less than one per cent. in 1936—a most satisfactory state of affairs.

### COTTON.

Reports recently to hand show that Fiji grown Sea Island cotton has been given top London prices for the grade again this year. In addition, Fiji hybrid cotton has gained 14 pence per lb which is quite satisfactory. The reports indicate that Fiji grown cotton is a good commercial product and only requires to be produced on a larger scale for the benefit of the Colony.

### FIJIAN PEASANT FARMERS.

In Tholo West there were, in 1936, ninety-three " exempted " Fijians of whom seventy-nine were actively and contentedly engaged on their own lands in agricultural and pastoral pursuits. All these seventy-nine men now have their own houses and own in the aggregate 365 horses, 603 cattle, 99 pigs, 474 fowls, 23 goats while they have 259 acres under cultivation comprising 107 acres of food crops, the balance of the total area being occupied by yanggona, maize, rice, cotton, and tobacco.

These figures indicate a healthy state of affairs in this Province and appear to warrant the extension of " exemption " privileges to as many men as are capable of working independently.

### DEMONSTRATION STATION, NDOMBUILEVU.

This station is in process of establishment and consists of thirty-five acres of good average land ideally situated as a demonstration area, with a long road frontage on King's Road.

The area has been fenced, partially cleared, and a small part planted with food crops and cotton, while a nursery area has been laid out. A " mbure " has been erected for the Native Field Assistant in charge and the preliminary work well advanced for the next planting season.

Distribution of seeds and planting material is already taking place from this centre to the adjacent Fijian Settlement where fourteen men have recently commenced work on the land. These settlers are naturally encouraged to plant their food crops first, attention later being paid to cash crops. Many of them appear to be showing good promise of becoming useful peasant farmers.

### PASSION FRUIT.

The demand for passion fruits and for tinned passion fruit pulp has recently increased considerably in England, New Zealand, and Australia, and should present possibilities for local cultivation. The soft skinned fruit types grow abundantly in some areas and would provide good pulp for export while the hard skinned types could be used either for pulp extraction or for export as fruits. Information regarding cropping abilities of the various types occurring in Fiji is being collected and any definite figures of yields by local growers will be very welcome if sent to the Department of Agriculture.

### TOBACCO.

Approximately 8,000 lb of Fiji " stick " tobacco were sold remuneratively in Fiji in 1936. This trade is in its initial stage but should continue to develop slowly and thus afford a small market for locally produced Fijian leaf. The export market for this product is still under experiment, many difficulties being experienced.

# REVIEWS.

## PLANT BREEDING ABSTRACTS, SUPPLEMENT II, SUMMARY OF REPORTS RECEIVED FROM STATIONS IN THE BRITISH EMPIRE 1932–35.

(Imperial Bureau of Plant Genetics, Cambridge, pp. 63, 5s., April, 1936.)

THIS supplement to *Plant Breeding Abstracts*, also a publication of the Bureau, represents the result of a tremendous amount of work undertaken in collecting, collating, and indexing and presenting in a concise form, information relative to all phases of plant breeding to be found scattered throughout some 400 Annual Reports of Departments of Agriculture throughout the British Empire.

The general layout makes it a most useful book of reference, of general interest and value to research workers and particularly to those workers who are situated in the distant parts of Empire where facilities for contact with those doing similar work and access to relative literature are at a minimum.

In general, the Annual Reports of a Department of Agriculture represent the chief means the average research worker has of securing publication of his work and its results. Such reports have a restricted circulation, hence the activity of the Bureau in rendering such work available to all concerned in plant breeding is of particular value.

The publication covers a wide range of climate and crops, other than herbage; includes references to diseases, pests and their control; plant breeding, genetics and cytology; all planned to render reference easy and complete and the book is well indexed.

Such reviews are invaluable to all those engaged in plant breeding and modern genetics in relation to agriculture in giving a comprehensive survey throughout the whole field of plant breeding.

A similar review is in process of compilation from reports received from countries outside the Empire and will complete make a valuable contribution to plant breeding works of reference.

—H.R.S.

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## CULTIVATION OF CITRUS IN CEYLON.

By

T. H. PARSONS, F.L.S., F.R.H.S.,
Curator of Royal Botanical Gardens, Paredeniya, Ceylon.

(*Tropical Agriculturalist*, Vol. 87, No. 3, 1936.)

THE article is stated to be a revision of leaflet No. 59 of 1930.

Interest is being slowly stimulated with consequent increase in acreage of this crop, but not sufficient to make citrus a major crop. Areas are available where conditions would appear to be favourable. Capital is required as well as a rigid insistence on the use of the best material and methods.

Some statistics as to cropping areas and production for the main producing countries are given, including the increases recorded for South Africa, Jamaica and Palestine for the period 1930–34. It is pointed out that only one per cent. of the world's output is produced between latitudes 20° N. and 20° S. of the equator, the other 99 per cent. coming from between latitudes 20° and 40° in both hemispheres.

Ceylon being situated between 6° and 10° N. of the equator would appear to be outside the normal citrus belt but the varying climatic conditions of

its highlands make it comparable with Jamaica where under similar conditions cultivation and production is extending, provided suitable types and varieties are obtained and proper cultural methods adopted.

Stocks suited to Ceylon are discussed. It is pointed out that the local fruit is coarse, thick skinned and invariably green when ripe due partly to inherent characters, heavy rainfall, lack of cultivation, tropical environment bad drainage, &c.

Methods for the improvement of fruit through budding are indicated.

Reasons for the variation of yield of different trees within an orchard are offered and the characters of Ceylon stocks considered of importance owing to being invariably of seedling origin.

When seedlings are budded it is stated that the scion has a levelling effect on growth and performance, therefore the necessity for discarding all seedlings other than those of regular size and appearance is emphasized. A budded or grafted tree is not necessarily superior to a seedling tree but the stock may be more hardy in the sense that it may resist cold or heat, excessive moisture, &c., better than the parent tree.

Stocks suggested by experiment are the Sour or Seville orange, pumelo and rough lemon. Sweet orange has been largely discontinued as a stock, owing to its susceptibility to "*Mal de Goma.*"

Rough lemon and sweet lime are of rapid growth and carry early fruiting qualities to the scion, are strong rooting and withstand drought; a disadvantage is that these stocks are shortlived, particularly in the moister zones. The pumelo and sour stock, however, are slower in coming into bearing but much longer lived.

Imported plants from reliable outside sources are recommended to secure a supply of proved budwood.

The general conclusions arrived at from experiments undertaken at Peradeniya are that the following stocks are recommended:—

1. Rough lemon, pumelo, sour orange and possible the lime for low country and moist conditions.
2. Sour orange for up country, moist and semi-dry regions.

VARIETIES.

*Oranges.*—The four main groups in cultivation are:—Spanish, Mediterranean, Blood and Navel, of which the Navel predominates in Ceylon. Varieties generally in cultivation are—W. Navel, Mediterranean Sweet, Valencia Late, Pineapple, Jaffa, St. Michael and Malta Blood. The Jaffa and Mediterranean Sweet bear early fruits, W. Navel, Pineapple and Malta—mid season, the remainder late season fruits.

Of mandarins, the "Indian Nagpur" is recommended for all low country conditions being loose skinned and able to withstand the extreme heat well. Under Indian conditions it is a double cropper but under the semi dry conditions of Ceylon, bears once a year only. It is stated to be equal to the famous "Dancy" mandarin of California and Florida.

The "Sylhet" orange, an Indian tight skinned variety is highly commended together with the "Emperor" and "Beauty of Glen Retreat" which require some elevation for the best results.

Eureka, Lisbon and Villa Franca lemons are varieties well suited to most parts of Ceylon, irrespective of root stock.

Limes are stated not to pollenate freely therefore budding is not so essential. Seedless limes however must be budded.

The cultivation of grapefruit is most successful in the warmer and moister low to mid-country districts provided there is good drainage. Stocks recommended are sour orange, pumelo and possible rough lemon.

"Marsh Seedless" variety is preferred on account of its seedlessness, robustness on various stocks and adaptability to varying conditions.

Other varieties grown are:- Walters--considered earlier than the "Marsh"; McCarthy, Pernambuco, Cecily's seedless and Triumph, in order of importance.

PROPAGATION AND PLANTING.

Propagation is by budding. Seed of thoroughly ripe fruit from strong healthy trees is extracted, graded, only the plump, heavy seed being sown, the remainder discarded. The seed is not allowed to become dry and should be washed before planting.

The seed bed is carefully prepared in good soil, well drained and sheltered. When seedlings are 4 ft.–6 in. high they are transplanted into rows 12in.–15.in apart using only the strongest and best, and of uniform size.

Budding and bud selection is described and it is stated that the best results are obtained under light to moderate rainfall.

The "Rectangular" or "Patch" budding, the upright and inverted are recommended, the latter giving the best results at Peradeniya.

PRUNING.

The reasons, objects and methods of pruning are discussed in general and the difficulty of the problem with reference to citrus is indicated, the recommendation being to prune first to shape the tree, then to use the knife as little as possible afterwards except for the removal of dead wood and branches obviously in the way, but having due regard to the shape of the tree.

MANURING.

Light dressings of farmyard manure are recommended and also an annual dressing of from 4-8 lb per tree of an artificial fertiliser mixture containing N : P : K in the proportion 4 : 2 : 1.

CROPPING.

Budded plants should begin to bear at the third year from budding, grape fruit at the fourth year in moist zones if the stock is pumelo or sour orange.

The first crop should not be allowed to exceed 8–12 fruits per tree, while full crops comprise anything from 300–600 fruits per tree, an exceptional tree may produce 1,000 fruits per annum.

The unit of production is the individual tree, there being good and bad bearers.

—H.R.S.

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## ON THE SEEDLESSNESS OF CITRUS FRUITS WITH PARTICULAR REFERENCE TO MARSH GRAPE FRUIT.

By

N. WRIGHT,

(*Trop: Agriculture*, Volume 13, No. 5, May 1936, and reprinted by *Trop: Agriculturist*, Volume 87, No. 1, July 1936.)

CLOSE competition and the rigorous standards demanded by the fruit market is held largely responsible for the attention now being given by citrus growers to the problem of "seedlessness."

The mechanism of fruit development in citrus species is peculiar and is not shared by the majority of other fruit trees. Structurally the fruits are all many seeded and in the more primitive varieties the ovules readily develop when either self or cross pollinated but, if not pollinated fruit does not develop.

In the more highly developed varieties failure of seed formation does not prevent fruit development—which is then said to be parthenocarpic. Such varieties are potentially seedless although seeds are often found in them. Such a result is due to a variety of factors of which self-sterility and cross-sterility are perhaps the most important.

Sterility may be due to structure involving the ovules (female sterility) or the pollen (male sterility) or both, which may be partial or complete. Almost complete structional sterility occurs in the Washington Navel and Satsuma oranges, the young ovule seldom reaching maturity and no viable pollen being produced.

Investigations into four varieties of tangerine with fertile pollen showed they produced fully seeded fruits on cross pollination but completely seedless fruit when self-pollinated, demonstrating that irrespective of the condition of pollen, partial female sterility reduces the number of seeds produced and complete female sterility results in complete seedlessness. Male sterility of like character would produce similar results. A further complication is the formation of " apogamic " seed which may develop without fertilisation the progeny being identical with the mother plant from which it was derived by vegetative growth.

The " Marsh " variety of grape fruit may be called commercially " seedless," it is recorded as containing from 2–6 seeds or more, but opinion has it that it may contain as few as twelve or as many as forty to eighty seeds, suggesting varying conditions of seed formation and the question as to whether the seeds are of apogamic origin or the result of fertilisation.

The foregoing indicates that a seedless fruit must be at least self-sterile but if such fruit developes seed then the cause may be two-fold:—

either it has been pollinated by a cross fertile variety,
or it has acquired self-fertility through a genetical change in its constitution—a mutation or sport.

In the Tahiti lime, which is classed as a completely seedless variety investigations indicate that the structure of the flower renders seed formation impossible; this also applies to the Satsuma orange but in this case cross pollination is a possibility. The work of other investigators suggests inconclusively that the " Marsh grape fruit," Lisbon lemon and Sweet lime are harmless to some citrus, while Valencia late, Baladi, Duncan, Yusuf effendi tangerine, and sour orange cause appreciable increase in seediness.

Controlled hand pollination experiments using pollen of the above varieties produced increase of seed as compared with self pollination, varying from 2·1 to 5·0. The author also presents figures indicating that trees giving large numbers of seeds have more viable pollen than trees yielding sparsely seeded fruit. Finally his observations on annual variations in seed content of a single tree suggest that weather conditions may be responsible for variation is seediness.

Observations on the seedlessness of pumelos may serve to indicate the habit in the grape fruit—their nearest relative. Thus, in Siam, the largest crop is picked in November . . . . . " though at other seasons the fruits are more seedless." A photograph of two half fruits taken from the same tree but at different times of the year shows one completely seedless and the other fully seeded. Also trees have been observed bearing seedless fruit except on branches extending towards other varieties of regular seed producing habits. It is recorded that seedless varieties of Siamese pumelos introduced into the Philippines produced large numbers of seed in normal

sized fruit, undersized fruit being more or less seedless. Cross fertilisation is the suspected cause of this seediness, a suggestion strongly supported by Hawaiian experience in which fruit from the spring crop, set at a time when few other citrus varieties are in flower is seedless, whilst the " main crop " fruit set when other citrus trees are in flower is heavily seeded.

Bud mutation is relatively frequent in citrus but it is significant that only in Marsh Grape fruit was a mutation found affecting the seed content of the fruit. Of 500 trees examined 123 gave fruits yielding 30-90 seeds per fruit. Two strains were recognised - a " Rough seedy " and a " Smooth seedy." The principal characters of the two strains are enumerated and afford the most definite information yet available with reference to a mutation affecting seed content.

The foregoing remarks indicate at least two sets of circumstances, which separately or together may offer a reason for the increase of seed content in a " seedless " variety of citrus, but it is necessary to be certain which variety is concerned. The remedy will therefore, depend upon the most important of the factors which experiment might reveal.

The tree that consistently bears seeded fruit should be regarded with suspicion and efforts should be made to trace the origin of budwood before use and in rebudding care should be taken to exclude foreign pollen from the tree.

The remedy consists in either replacing the tree by another; or by top-working the existing tree, the choice depending on the age of the tree, number of trees to be dealt with &c.

If seediness of the fruit is proved not to be transmitted by budwood, then it is suggested to " concentrate first on the possibility of cross pollination." by congenial varieties near to or within the orchard, the factors to be observed being flowering time and its coincidence with the period of grape fruit bloom. Such trees should be removed.

Mixed orchards should be avoided and efforts should be made to eradicate other varieties when recognised, even reputed " seedless " types since their pollen although self sterile may be fertile to the variety under cultivation.

Attention is drawn to the possibility of both cross pollination and mutation operating together. A single mutant tree or even only a limb may produce seediness in a number of trees growing near to it.

Growers are advised to check seedlessness in fruit by counting the number of seeds found in a representative sample from each tree. Trees bearing seeded fruit should be marked and the crop marketed separately. Also such trees should be examined to determine if only one branch is affected. Counts over a number of seasons will be necessary to confirm seediness and if proved the branch or tree should be removed.

In conducting preliminary investigations into seediness 25 fruits per tree is suggested as sufficient to prove real differences between two trees in 95 per cent. of cases. Such a sample should comprise fruit from all parts of the tree during the fruiting season.

As regards pollination experiments—intensive work on a few trees will probably yield more valuable results than a number of scattered pollinations over a wide area.

In conclusion it is stated that the solution of the problem of seediness is not a simple one and that only carefully recorded and controlled experiments will give essential results.

—H.R.S.

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# AGRICULTURAL JOURNAL

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## EDITORIAL.

AT the opening of a recent meeting of the Legislative Council, His Excellency the Governor mentioned that "there was a time when the organization of life in Fiji was very simple and that Government was a negative business seeking only to guarantee to the citizen security in which to carry on personal undertakings. To-day that simplicity is rapidly passing away," and thus must all officers of the Government be prepared for more complicated and far more intensive service and this indicates that progress is being made. His Excellency stated that he believed "in the future of Fiji and in the prospects of harmonious co-operation between the Fijian, the European and the Indian," and his optimism is pleasingly reasuring especially as we are undoubtedly living in a world of change.

The Department of Agriculture is endeavouring to assist agriculturists to meet changes (which are fast becoming obvious to those who mix with and know small agriculturists) and to instruct and guide them along sound lines.

For the Fijian, the most important crops are, of course, his food crops which he is primarily encouraged to plant and maintain in more sufficient quantities, and which he, in fact, does normally maintain of his own accord whenever he is permitted to do so.

Next to his food crops, the most important local crop which concerns Fijians is copra of which the export value last year was assessed at £404,000. The Fijians produce more than half the total output of the Colony and hence special efforts are in progress with a view to assisting them to improve their crops and their finished products and to plant more palms wherever conditions are suitable for this crop.

Since the July issue of the *Agricultural Journal* was printed the thirteenth Annual Show has been held and the various displays of fruit and vegetables and divisional exhibits brought home to the public some of the activities of the Department of Agriculture.

A visitor to the Colony of unusual importance was Sir Frank Stockdale, K.C.M.G., C.B.E., who is the Agricultural Adviser to the Secretary of State for the Colonies. His purpose in coming to Fiji was to report on agriculture and its practice in the Colony and the organization of the Department of Agriculture and his report on this subject will be awaited with interest. Sir Frank has had tropical experience in Barbados, Mauritius and Ceylon, being formerly Director of Agriculture in the last named Colony. Within the last few years he has paid official visits to India, the West Indies, East and West Africa, the Seychelles, Sudan, Egypt, Cyprus and Palestine and his reports on these countries are peculiarly informative. His visit to Fiji was most stimulating to officers of this Department.

The present *Journal* contains a very interesting article on soil erosion which is of a paramount importance to a country in the agricultural stage of development reached by Fiji. The marked difference between contour cultivation in the dry zone and its virtual absence in the wet is well brought out. The pernicious practice of shifting cultivation and its attendant results is stressed: with the example of parts of the United States as a warning it is incumbent that steps be taken here while there is yet time. The question of forest conservation in the highlands comes at a convenient time as the secondment of a Forestry Officer from Malaya has been approved by the Legislative Council.

The development and scope of the Imperial Agricultural Bureaux is dealt with in another article and gives some idea of what assistance is obtainable from such a unified organization which is sure to be utilised to the full by all the Colonies and Dependencies.

Under Veterinary notes, the success attained in the control of tuberculosis in dairy herds in the Suva District is traced and is highly creditable in that incidence of the disease was reduced in a period of four years from 18 per cent. to 0·4 per cent. of the cattle treated—20 herds being registered as free from disease. The extension of control of this disease is envisaged over the next five years but progress must necessarily be slow for financial reasons from the dairyman's point of view and because of limited staff from the Government aspect.

The symptoms of infection keratitis are briefly described and simple methods of treatment of the disease are indicated. The position regarding contagious abortion has so improved that it may now be said to be satisfactory; evidence indicates that innoculation with live vaccine has helped to control the disease.

Importers of pedigree cattle from Australia are requested to note that the embargo on such imports on account of ephemeral fever cannot yet be removed, but the situation is being watched by the Department. In addition simple treatments are given for dermatomycosis in dogs.

It is hoped that the Index for Volumes 5—8 will be found useful.

## IMPERIAL AGRICULTURAL BUREAUX.

WITH the development of the Unified Colonial Agricultural, Veterinary and Forestry Services, development of Imperial Bureaux has also progressed materially in the past decade.

There is now an Imperial Bureaux dealing with each of the following subjects:—Agriculture, Forestry, Veterinary, Dairying, Parasitology, Mycology, Entomology, Plant Breeding (pastures), and Plant Breeding (other plants).

In the *Empire Cotton Growing Review*, Vol. XIV, No. 2, Sir David Chadwick, who is Secretary to the Executive Council of the Imperial Bureaux, gives a general summary of the work of these Bureaux and from his summary the following extracts may prove of interest:—

"The general term, "Imperial Bureaux," covers a group of agencies. Each deals with a specified subject or science. Each is located at a specially suitable research institute. Each is very similarly organized with very similar objectives, but each is developing to meet the chief demands of its clients. Yet all work in conjunction and all are under the one general control, the Executive Council of the Imperial Agricultural Bureaux. This Council is composed of

the nominees of the governments of the Empire who in mutually agreed proportions provide the funds for the work of the institutes and bureaux controlled by the Council. The organization is thus trebly co-operative. Each agency seeks to promote knowledge and co-operation among the scientists in the Empire engaged on its subject. The several agencies work in conjunction, not in competition. Taken as a whole they are a constitutional experiment in joint imperial administration.

The activites of the institutes and bureaux vary somewhat, but the chief an common purpose of them all is the collecting, indexing, abstracting of all information in the world as it becomes available in its own branch, and its distribution to the research workers in the Empire interested therein. For this purpose each institute or bureau publishes an abstracting journal which is placed on sale. Also, from time to time the bureaux issue special monographs. These are either reviews, with bibliographies attached, on the state of knowledge of some special subject at the time of issue, or descriptions of technique. In the years from 1930 to 1936 over 110 of these special publications have been issued, covering subjects such as soil erosion, vernalization, the arrangement of field experiments and the statistical interpretation of results, the technique of artificial insemination, vegetative propagation of tropical and sub-tropical fruits.

Each institute or bureau must take special pains to maintain contact with research institutes and workers everywhere in its own subject, and is organized to obtain and search all journals. But it is not a mere library service which is offered. The staff of each institute and bureau must necessarily be highly trained linguistically, but the officers at the head are in every case specialists in their own branch of science. The reason for locating the institutes and bureaux at well-known research institutes is to ensure that the officers of the bureau are in full current of their subject and meet and see specialists from other countries. Necessarily the articles abstracted are fewer than those indexed, but the close association of the bureau officers with active research workers everywhere, helps such selection as is needed. In the larger subjects the aid of specialists outside the bureau is enlisted in abstracting. In every case the work is supremely up to date and the object is to keep it "live."

Whilst the collection and dissemination of information is the chief of their services they have all repeatedly been asked for help in other directions: for translations, for introductions to other research workers, for aid in obtaining experimental material for information on technique and methods, &c. In the two older Institutes of Entomology and Mycology another form of service is a regular part of their duties. That is assistance in the indentification of specimens. Each of the Institutes has a small highly trained staff of specialists for this work; each has also obtained the co-operation of specialists elsewhere. The Institute of Entomology sends out on the average every day of the year a list to some entomologist in some Empire country giving him the names of insects which he has sent to the Institute for identification. On the average the insects so named exceed 8,300 a year, of which over 400 prove each year to be new to science. These applications for help come from every Dominion and every colony, and it will be readily understood that it is with the more difficult identifications that the aid of the Institute is sought. At the Mycological Institute similar aid is given to the mycologists in the Empire. A room is also maintained in which mycologists from overseas can come and work at their own problems.

The laboratory at Farnham House exists to help entomologists in obtaining parasites which they may require and cannot get locally, and also to aid them with information on this specialized subject. In the year 1936-37 over 20 million parasites have been shipped overseas through Farnham House. These have been collected from many parts of England, from Czechoslovakia from Hungary, from Scandinavia. In the current financial year a consignment has been despatched to some overseas Empire country on the average every other day. In the course of all its work much information of value and biological control has been collected, and one of the problems is to make that knowledge readily available.

The keynote of all this work, whether in the institutes or in the bureaux, is service to the research worker and to the scientist. It is not part of their functions to advise the farmer or the landowner. That is the duty of the national departments. When such requests are received, as they are from time to time, they are forwarded to the local department with or without additional information as the case may be."

## SOIL EROSION.

By

H. W. JACK, M.B.E., B.A., D.Sc., M.L.C.,
Director of Agriculture and Conservator of Forests.

THE importance of problems of soil erosion and dessication in the Empire was recently stressed by Sir Frank Stockdale, Agricultural Adviser to the Secretary of State for the Colonies, when he addressed an informal meeting in London of Forest Officers from all parts of the Colonies.

In his address Sir Frank first considered the problems from the physical aspects of climate, soil, steepness of slope and rainfall.

He pointed out that many soils eroded more rapidly than others, the rock-base possibly having an important influence on this character, and instanced the low liability to erosion of heavy calcareous soils in Jamaica compared with the rapid rate of erosion in soils derived from schists.

The steepness and aspect of slopes and the distribution of rainfall were other important factors affecting rate of erosion. In areas subject to a long period of drought, erosion was intensified since soil-particles tended to dry out and become surrounded with a layer of air which retarded absorption of moisture and the wetting of the soil.

From the biological side he stated that the problem involved an understanding of vegetation and the reactions to the way in which land was used for purposes of agriculture and pasturage, man-made erosion being usually due to interference with the vegetative cover and was capable of material retardation and prevention by protection of streams and general methods of conserving water supplies in the soil.

Thirdly, he stressed the fact that the livelihood of the people is always of paramount importance, and that such customs as shifting cultivation, cannot be abruptly upset but that attacking the problem in such economic and social circumstances can be successful by gradually building up a continuous system of agriculture aiming at intensification of agricultural operations in place of the practice of extensive native methods. He stated that there were two methods of counteracting shifting cultivation such as is practised in Fiji. One way was by providing a good rapid growing cover when land was thrown out of cultivation, the other was by the adoption of animal husbandry and mixed farming as a means of maintaining fertility.

As regards Fiji, it may safely be stated that soil erosion has been taking place for a considerable time as is evidenced by the general flat topography of the low red hills, the fineness of the soil deposited in valleys and the greater fertility of such soils in comparison with the residual eroded materials.

Many of the so-called river flats in Fiji are not composed of true alluvium, but are a mixture of true alluvium and the fine soil from the neighbouring eroded low hills (*i.e.* colluvial soils). The fertility of these soils is due in no small measure to their admixture with the eroded surface materials. Many profiles examined in the course of soil survey studies suggest the complete erosion of the surface horizon and the infertility of several soils can be directly attributed to this cause.

Much erosion by water action is masked by the system of native agriculture which permits of rapid growth of secondary vegetation in eroded

areas; nevertheless, sheet-erosion is very prevalent particularly in soils overlying soapstone and volcanic tuffs.

In the neighbourhood of Suva the soapstone is covered in many cases by only a few inches of soil, and although this formation is fairly recent there are locations where from natural causes erosion has been prevented and several feet of residual soil exists in association with the parent material.

In the Kalabo area the erosion of two feet of soil in the course of five years has been recorded. Again at the Experimental Station, Nasinu, particularly shortly after clearing, it is possible to witness sheet erosion and in small depressions the sandy clay soil type is mechanically separated, the fine silt and clay being washed away and the coarse and fine sand left to tell the tale. Chinese market gardeners are cultivating garden food-crops on an extensive scale at various sites along the Prince's Road, most of the cultivation being on sloping lands and, in the normal Chinese manner, clean weeding forms a feature of their agricultural routine. Erosion is extensive in certain locations in this area, and Chinese market gardeners have been known to build up soil in eroded locations, without making any provision for its subsequent retention.

In general, it can be stated for Fiji that wherever land is cleared of timber and subsequently cleared for cultivation, sheet erosion takes place in the undulating country and its severity depends upon the type of crops grown, the slope of the country, the soil type, system of cultivation and soil management, while in the steeper country cleared of forest, gully erosion is prevalent.

Practically all the alluvial flat country of Fiji is under cultivation or pasturage and apart from flooding there is little damage caused by erosion of these soils, since, as a rule they are very fertile and are mostly managed by the Colonial Sugar Refining Company whose methods of liming, green manuring and crop growth give rapid results. Where they are left to fallow, these soils are soon covered by a thick mat of sensitive plant, and Para and other introduced grasses. Organic colloids are high in these soils and owing to the binding nature of the organic constituents, they thus resist erosion to a great extent. Erosion through overstocking of flat pastures is almost absent in Fiji but on the slopes of the hills erosion is more noticeable, particularly where no provision has been made to retain the soils.

Many of the soils of Fiji—due to absence of organic colloids and their peculiar mechanical composition, a high content of fine silt and fine sand—are very easily eroded. These soils, if cultivated, expand and contract during wetting and drying, forming in some cases a patterned surface, and in others deep and extensive cracks. Where cracks are extensive in soils overlying soapstone, the percolation of water to the slippery soapstone surface has the effect of moving soil *en masse* on the sloping surfaces. The extent of this movement is controlled by the mechanical composition of the soil, the depth to which cracks extend, the amount of cultivation and the slope of the land.

In the dry zones of the Colony, contour cultivation of the hilly lands is frequently seen but in the wet zones Indians tend to plough up and down hill in order, it is stated, to facilitate drainage and in consequence much erosion takes place and frequently results in the flooding of roads in rainy weather.

Outside the sugar cane areas the system of agriculture adopted by the Indian peasant is to till the soil, plant one crop and to continue with that

crop until the soil is exhausted or the crop succumbs to disease. He then moves on to another selected area and continues the same wasteful practice. The exhausted areas are then abandoned and apart from the fact that no provision is made during cultivation to conserve soil, the exhausted condition of the soils after abandonment, is such in many cases as not even to permit of a quick return to natural conditions as instanced in the Kalabo area near Suva.

The Fijian shifts his cultivation at frequent intervals and although this practice is wasteful it has the merit that soils are not exhausted and usually revert fairly rapidly to natural conditions. Also, the Fijian very rarely clean-cultivates his land and some of his methods definitely tend to counteract erosion of the soil. Thus, in soils subject to sheet erosion the native method of disturbing only the soil in the immediate vicinity of the planting hole causes little erosion compared with the Indian method of entire tillage of sloping areas.

The Department of Agriculture through its Field Agricultural Officers and Demonstration areas, is attempting to teach the native a sounder system of agriculture, based on soil management and crop rotation. By this means it is hoped in time to limit his agricultural effort to a definite area which he will farm according to the advice and under the supervision of the agricultural Officers who have, in certain areas, demonstrated the conservation of soils on hillsides by contour cultivation, terracing, liming, green manuring and cover cropping.

The serious nature of soil erosion in Fiji is not fully appreciated at the present time, but it may be pointed out that areas which have suffered extreme erosion are being abandoned; many of the eroded areas are close to roadways, waterways, and ports, and new land is being opened up in steeper areas and is thus more subject to erosion. The total available agricultural land is ample for the present population but with increasing population exhaustion of soil and soil loss through erosion will steadily become more serious factors in land settlement and hence, the gradual adoption of a soil conservation and restoration policy is indicated.

Amongst well known methods for counteracting soil erosion, mention may be made of contour terracing, contour tillage, strip cultivation, broad-base terracing, contour hedges, cover cropping, rotation cropping, contour planting of protective belts of trees, mechanical means (usually too expensive, except in highly populated areas) the maintenance of permanent cover (forest) on steep slopes, mountain and hill tops and reafforestation. These and other methods of conserving soil moisture lead to the growth of agricultural and cover crops which in turn conserve and bind the soils. Gully erosion is of common occurrence in Fiji and requires special methods of control including the provision of diversion channels to direct flood and stream water away from the gullies, the erection of brushwood and other inexpensive dams, and the planting of suitable trees on the slopes and bottoms of the gullies. Small gullies can also be filled by ploughing across the contours.

The agricultural education of all races is important as a factor in the gradual reduction of losses of soils and of soil fertility: instruction towards this end is already being given by the Department of Agriculture through its officers and by ocular demonstrations at various native agricultural centres where such work is still very much in its infancy.

The principal causes of our soil erosion are undoubtedly shifting cultivation, uncontrolled timber cutting, fire and to a much less extent, grazing. The general effect of these forces is already rendering much of our accessible land infertile and unremunerative and in consequence it is desirable that attention should be directed to the need for the proper use of our soils and our vegetation which combine to form the greatest asset of this Colony. The task of preparation is Herculean, but much can be done if the many persons concerned each endeavour to do their own little " bit " towards the reduction of erosion and thus endeavour to leave to their descendants a valuable inheritance of land on which fertility has been built up by wise and judicious means of cultivation and utilisation.

The problem of repairing the destruction of soil fertility resulting from erosion by water, wind and heat, is gravely exercising the minds of many nations to-day, particularly in Africa and North America where many millions of acres of rich fertile soils have been dissipated in the course of a few generations—even within the memory of living men.

Fiji is still fortunate in that loss of vegetation and erosion have not yet been extensive, thanks to sparse population, but enough damage has been done to indicate the need of watchfulness to stem its progress and of education to stimulate agriculturists to economise in their use of land. Also needed is a sound permanent system of farming leading to the establishment of a permanent native peasantry in contrast with the unsettled shifting cultivation which accompanies communal agriculture at present.

## THE FIJIAN COPRA DRIER.

By
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and
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WHILE it is well known that good sundrying conditions can produce the best of all grades of copra, it is not practicable in most coconut-producing areas of Fiji to place sufficient reliance on sundrying. Hence, where sundrying is practised it is wise to have available some means of artificial drying, should weather conditions prove treacherous and unsatisfactory for the purpose of sundrying.

Efforts to introduce to Fijians artificial methods of drying of copra are definitely meeting with a fair measure of success, since although it is barely twelve months since such methods were inaugurated, already over 100 small kilns are operating, each kiln being capable of turning out 12 to 20 tons per annum, assuming that at least one curing is made each week. Actually, Fijians do not make a curing as frequently as once a week.

European planters also are beginning to recognize the fact that sundrying under the unreliable conditions of Fiji is obsolete and that if Fiji is to keep up-to-date, recourse to kiln drying, at least to some extent, is essential.

The type of small drier which is specially designed for slow drying by the Fijians is capable of turning out first quality copra provided that the routine established for this type of kiln and made known to the Fijians by native assistants, wireless talks, and by pamphlets (in Fijian), is reasonably well followed.

The same type of drier is being used by Europeans in several areas, but Europeans endeavour to speed up the drying and use mostly timber fires, with, in many cases, undesirable effects, which result in badly scorched and even burnt copra, and often a badly smoked product.

Unfortunately Fijians have in several areas copied these unauthorised and undesirable methods with unsatisfactory results in consequence.

It was never the intention of the Department of Agriculture that these kilns should be introduced to estates as unit kilns though it was hoped that estates would operate them as batteries, but in either case it is necessary to follow the routine methods for which the kilns are designed.

Now that European planters in some areas have shown themselves to be keenly interested in the possibilities of the small holders' copra drier when operated in batteries, some notes on the small copra driers thus operated are given later in this article.

While fair progress has been made, there has not been an immediate increase of quality in the copra produced by these kilns as many snags have been encountered, but it must be remembered that when the "better copra campaign" was started, it was definitely stated that it was anticipated that at least two years would elapse before the Fijians would settle down to the new idea of kiln-dried copra and of drying their own copra.

In the case of a number of small kilns operated by Fijians, it is pleasing to note that good quality copra is already being produced and it is anticipated that with further instruction and more supervision by native agricultural assistants, that the numbers of Fijians who will regularly produce good copra will increase materially and rapidly.

In this matter, the rapidity of improvement can be greatly accelerated by the helpful co-operation of the copra buyers in insisting on a good product,

which can now be turned out by the native in many areas, provided that the buyers persist inp urchasing only good copra or in penalising in some degree sellers of bad quality copra.

Hence the Department of Agriculture is anxious that all buyers should assist in this matter for the general welfare of the Colony, and in particular for the welfare of the Fijian who is now beginning to think and act for himself.

Many of the Fijians are still paying insufficient attention to the routine of drying copra as laid down in issued instructions, and hence, producing poor and smoked copra, consequently in this article it is intended to point out their main shortcomings with the hope that improvements will continue to be made, and that interested Europeans will co-operate with the Department of Agriculture is passing on these general instructions, which will also be circulated in Fijian.

For the sake of emphasis the standard routine of drying with the standard sized small kilns (6ft. x 6ft. drying floor) as illustrated in the diagram (attached) may justifiably be repeated as follows:—

Collect and husk 1,500 to 1,600 ripe nuts. Two men with practice can readily do this work in one day.

*First day.* FINE WEATHER ROUTINE.

6 a.m.—Split the nuts, discard bad ones or those with a germination core in excess of 1½ inch in diameter, turn the half-nuts, meat side downwards on a clean, well-drained surface, to drain for two hours.

8 a.m.—Invert the drained half nuts and sundry for 4 to 6 hours (less if sun fails, longer if the sun is strong).

Noon.—Set and light a single row shell fire of about 160 half-shells (dry and clean of fibre) as indicated in diagram (the fire is started early so as to warm the kiln).

2 p.m.—Place the partially sun-dried nuts on the warmed kiln. Maintain the single row fire till 8 p.m.

8 p.m.—Turn over the nuts, set and light another single row shell fire and maintain.

*First day.* WET OR DULL WEATHER ROUTINE.

6 a.m.—As for fine weather routine.

8 a.m.—Set and light a single row shell fire (as at noon above, in fine weather routine). Place the drained half-nuts on the kiln and maintain the shell fire till noon.

Noon.—Turn over the half-nuts on the kiln, set and light another single row shell fire and maintain till 8 p.m.

8 p.m.—Turn over the nuts, set and light another single row shell fire and maintain.

*Second day.* ALL WEATHER ROUTINE.

6 a.m.—Turn over the nuts on the kiln, set and light and maintain a double row shell fire as in diagram III.

Noon.—Allow fire to die down, turn over the nuts on the kiln, set and light another double row shell fire and maintain till midnight.

*Third day.*

6 a.m.—Turn over the nuts, set and light a single row shell fire, maintain till noon.

Noon.—Turn over the nuts, pick out any loose shells, set and light another single row shell fire and maintain till midnight.

*Fourth day.*

6 a.m.—Turn over the nuts on the kiln, pick out any loose shells, set and light a single row shell fire till noon.

Noon.—Turn over the nuts, set and light another single row shell fire and maintain till evening.

*Fifth day.*—Remove the copra, separating it from all shells.

The copra if properly dry should break under pressure with a sharp snap and reveal an even pearly surface. It should be piled loosely in a dry place and turned over daily for a few days before bagging. If convenient it may be placed in warm shunshine with advantage for a day or so before bagging.

## DEFECTS IN THE QUALITY OF THE COPRA.

### *Insufficient drainage before drying.*

As a result of careful investigations into the reasons for reported defects in the quality of the kiln dried copra, it has become apparent that insufficient drainage has been given to the split nuts in many cases.

It is of the utmost importance that the split nuts should drain for not less than two hours prior to sundrying or placing the nuts in the kiln (according to the weather).

Insufficient drainage results in discoloured copra, whereas bad nuts are eliminated at the start, careful draining followed by kiln drying should result in 85 per cent white copra, while if two hours drainage is followed by 4 to 6 hours sundrying before kiln drying, about 95 per cent. of white copra should be possible. There will always be a few discoloured nuts due to constitutional defects in a few palms.

### *Delay between splitting, drainage, and sun or kiln drying.*

All such delays tend to increase the percentage of discoloured copra.

Two hours delay results in over 20 per cent. discoloured copra; five hours delay in about 30 per cent.; ten hours delay in about 40 per cent. and fifteen hours delay in almost 50 per cent. of discoloured copra.

All such delays must be avoided if a good quality product is to be obtained.

### *Overloading the kilns.*

If more than 1,500 partially sundried or more than 1,200 drained but not partially sundried nuts, are placed as one charge on these small kilns, the copra is liable to become pitted and slightly scorched or discoloured, the percentage affected depending largely on the numbers in excess of the figures above quoted.

This result is explained by the fact that the hot moisture-laden air, on passing up through the deep bed of drying copra, tends to deposit some of its moisture on the cool upper layers of half nuts by condensation.

In these cool upper layers instead of drying, bacterial action is developed and the copra becomes pitted and slimy.

The lower layers on the other hand dry too quickly and tend to become scorched and case-hardened whilst the impeded ventilation causes the fire to burn unsteadily and to produce excessive smoke.

Thus, it is very important to follow the correct loading authorised for the size of the kiln.

### *Insufficient drying.*

In endeavours to speed up the curing process it frequently happens that copra which is insufficiently dry or not all dry, is produced. Should more rapid drying be required it is necessary to reduce the load on the copra

platform, by about half, as then the required amount of moisture can be driven off in a proportionately shorter time by the standard firing, which is designed to dry 1,500 nuts in 3 or 4 days.

It is of value to mention that in Ceylon and Malaya large estates maintain an average drying routine covering four full days, which practically eliminates scorching, burning, pitting, discolouration, and under drying. Many of the estates in those countries use the same principle of drying as that employed in the standard small kiln now advocated in this Colony for Fijians and other small holders.

On large estates such kilns are worked in batteries of four or more under one roof. A diagram and brief description of such a battery may be found below.

*Scorching and Smoking.*

These defects are those most commonly experienced in kiln dried copra and may be caused by—

(*a*) overloading the kiln.

(*b*) insufficient drainage of the split nuts;

(*c*) insufficient or incorrect ventilation in the firepit or more often in the covering building (bure). The bure should be given ample top ventilation to permit the rapid escape of moisture-laden hot air and it has been found that a bure built and roofed with plaited coconut or sago leaves gives better results than an ordinary Fijian bure, and is cheaper to erect;

In the use of either type of building ample ventilators should be provided and care should be taken that the half shells are dry and moderately clean of fibre;

(*d*) it is essential that the baffle-plate should hang evenly as an unevenly suspended baffle-plate will result in scorching, uneven and insufficient curing, and in some cases, burning;

(*e*) scorching may also be caused by dirty baffle-plates and it is advisable to see that the baffle-plates are clean prior to each charging of the kiln;

(*f*) failure to turn over the nuts according to routine or at least once daily may cause scorching;

(*g*) smoking may also be caused by the half shells being jammed too tightly together in the fire pit.

In addition, it may be noted that copra which has been insufficiently drained will tend to become more smoky and more scorched than well drained or presundried meat.

*Burning.*

Serious scorching and burning have been noticed in some cases and can usually be traced to overloading or overfiring, but Fijian copra produced in the small kilns show less burning on the average than copra dried on some estates using various types of driers or with timber fuel, as judged by a recent tour of Vanua Levu and Taveuni.

If the routine for small kilns is reasonably well followed burning, should never occur though slight scorching may owing to the omission of turning the copra at least once daily during curing, especially on the second day.

Badly germinated nuts however tend to become scorched or burned and hence should not be included with the kiln dried copra.

*Excessive Free Fatty Acids.*

This is almost entirely absent in copra produced in the small kilns by Fijians.

A recent examination of twelve samples selected at random from twelve kilns in various parts of the group, operated with and without departmental supervision showed a percentage of free fatty acid varying from 0·08 per cent. to 0·35 per cent. which is extremely good as compared with the average for South Seas copra which stands at around 6 per cent. to 8 per cent. or even higher.

In the few cases where free fatty acid was noticeable it was invariably due to neglect in the continuity of curing or in long delay between splitting the nuts or cutting out the meat or due to the purchase of " green " copra.

All these causes of this defect will tend to diminish as the Fijian becomes more an individualist and works for himself instead of working for a community in which he has only a small share of interest.

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## FIJIAN COPRA DRIER FOR ESTATES.

In response to numerous enquiries from interested planters, a short description of the Small Copra Kilns, when operated as batteries of four or more kilns, has been prepared.

The small copra kilna, with a capacity of 12–20 tons per annum, is designed primarily for the use of small-holders. Some European planters have endeavoured to utilise the small-holders' kilns as unit kilns on their estates but have found that these kilns are of insufficient capacity for estate requirements.

However, combinations of kilns of this type are operating on many big estates in the East, where four-day drying is the rule rather than the exception —often drying extends to five days.

Before explaining the diagram and the method of operating the kiln battery, it may be mentioned that a battery kiln of four compartments, each of 6ft. x 6ft. drying floor, working every day, would produce a maximum of 90 tons of copra per annum, while a battery of four compartments with 10ft. x 8ft. drying floors could turn out double that quantity.

It may be mentioned that only one man would be required to attend to the splitting and draining of the nuts, firing, curing and handling of the copra after the husking which would be performed in the field by other workers.

The battery (see diagram) consists of one row of four kilns placed in line under a single roof. The dimensions of the small Fijian copra kilns are 8ft. x 8ft. on the ground and 6ft. x 6ft. on the drying floor. In the smallest battery the same area of drying space has been retained, but to simplify the working of the kilns and to avoid excessive handling the dimensions on the ground have been altered. The larger size of battery kiln would follow the same structural design as the small battery kiln.

In the small battery kiln compartments B and C in the middle are 6ft. x 6ft. ground measurements, but compartments A and D at the ends are 8 feet long and 6 feet wide.

In these combination kilns the outside walls at the end of the battery are sloping inwards but the remaining walls are vertical.

One single wall suffices to separate the various compartments so that three intermediate walls will be sufficient for the 4-battery kiln. The battery kiln may be constructed of sawn or rough bush timber or bricks or cemented rocks or other readily available materials.

Each compartment of the kiln is independently fired and operated and each compartment is constructed according to the principles standardised by the Department for small Fijian kilns in every detail.

Each compartment of the kiln being independently fired, must be provided with a small door.

The operation and curing routine of the small battery kiln is exactly the same as that recommended for the single unit kilns but it should be noted:

that Compartment A always holds the nuts for 1st day of curing.

| | | | | |
|---|---|---|---|---|
| do. | B | do. | 2nd | do. |
| do. | C | do. | 3rd | do. |
| do. | D | do. | 4th | do. |

The routine as described earlier in this article, for small individual kilns, should be followed carefully with the battery kiln, but for convenience is repeated below.

*Monday.* FINE WEATHER.

6 a.m.—Split 1,500 nuts, eliminate bad ones. Drain for 2 hours.
8 a.m.—Sun dry for 4–6 hours, longer if sunshine is strong.
12 a.m.—Warm up compartment A.
2 p.m.—Place the partially sundried nuts in compartment A and maintain single row shell fire until 6 a.m. Tuesday morning, turn over copra once during the day (say 8 p.m.).

*Monday.* WET WEATHER (as alternative to fine weather on the starting day).

6 a.m.—Split 1,200 nuts, warm up kiln A. Drain for 2 full hours.
8 a.m.—Place nuts in compartment A. Maintain single row shell fire until 6 a.m. Tuesday. Turn over copra once during the day (say noon) or better twice (at noon and 8 p.m.).

*Tuesday.*

6 a.m.—Transfer the half nuts from compartment A to compartment B. Maintain double row shell fire in compartment B. and turn the nuts over at noon. Refill compartment A with freshly split and drained half nuts after partial sundrying (if possible). Maintain single row shell fire in compartment A.

*Wednesday.*

6 a.m.—Transfer half nuts from compartment B to compartment C. Maintain single row shell fire in compartment C. Transfer half nuts from compartment A to compartment B. Maintain double row shell fire in compartment B and turn the nuts over at noon. Refill compartment A with fresh half nuts as before. Maintain single row shell fire in compartment A.

*Thursday.*

6 a.m.—Transfer half nuts from compartment C to compartment D. Maintain single row shell fire in compartment D. Transfer half nuts from compartment B to compartment C and maintain single row shell fire in compartment C. Transfer half nuts from compartment A to compartment B. Maintain double row shell fire in compartment B, and turn over the nuts at noon. Refill compartment A as before. Maintain single row shell fire in compartment A.

*Friday.*

6 a.m.—The copra in compartment D will be cured and should be removed, the shells being picked out carefully.

The process may be continued daily as shown in the above routine. During the transfer of nuts from compartment B to C or from compartment C to D, any loose shells should be removed from the kiln and while transferring the nuts from compartment to compartment the fire should be extinguished.

The dimensions of these battery kilns can be increased, if desired, to suit individual requirements of estates. Thus, increasing the copra platforms to 6ft. x 8ft. would increase the out-turn by about 25 per cent.; that is, about 2,000 drained presundried nuts or 1,600 drained (only) nuts. With a copra platform 10ft. x 8ft. the capacity would be increased to about 180 tons per annum at full capacity, but for this size the routine of firing would require to be altered as follows:—

(Compartment A.—Always two single row shell fires burning from opposite ends and placed in straight lines 2½ feet apart.

Compartment B.—Always 1 double row and 1 single row shell fire burning from opposite ends and placed as in A, alternating the position of the double and single shell fires as they burn out.

Compartment C.—Always 2 single row shell fires as in A.

Compartment D.—Always as in C.

For large estates, it is advisable to erect a battery kiln in each 300–400 acre block of the estate in order to reduce transport costs. Husking should of course be done in the field so that the husks can be retained on the land as manure and mulched round the palms. Splitting and drainage of the nuts is best performed at the kiln, so that time should not be lost in carrying out the general routine of drying since, as already explained, such delays are detrimental to the production of good quality copra.

Further information and advice will always be available on enquiry at the Department of Agriculture or from any of the Agricultural Officers stationed in the Districts.

GENERAL PRECAUTIONS.

1. Be sure to drain for two full hours after husking and splitting.
2. Be sure the baffle plates are clean before lighting fires.
3. Be sure your shell fuel is clean, dry and of uniform size.
4. Be sure you do not over-load your kiln.
5. Be sure to sundry on first day whenever possible.
6. Be sure your fires do not smoke much, they will not if they are burning properly.
7. Be sure you turn over your nuts in compartment B daily at noon, preferably twice daily and at least once daily for all other compartments.
8. Be sure you pile copra loosely and turn over daily for a few days before bagging.
9. Be sure you remove all shells before bagging.
10. Be sure you ram your bags well, the copra may be chopped into quarters, if desirable.

## TREES ORNAMENTAL AND USEFUL.

By
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THE use of trees for ornamental purposes is a feature of town planning and roadside planting in many countries, while few demesnes, public parks, gardens and open spaces exist without a background of trees, thus indicating that the value of a tree is not necessarily to be found in the amount of timber it will produce. Visitors to England and France are attracted by the planting of the Plane tree (*Platanus orientalis*) in the streets, public squares and market places of many cities and towns; in Germany many public roads are planted with fruit trees which give wonderful displays of flowers in the springtime and colourful fruit in the autumn; in Switzerland the Horse Chestnut (*Aesculus Hippocastanum*) is largely used to provide floral displays in spring and welcome shade in summer at the lake-side tourist resorts; in Egypt the Flamboyante (*Poinciana regia*) and in Australia the Gum trees (*Eucalyptus* spp.) are utilised, probably one of the best examples being the famous St. Kilda drive, the "Champs Elysées" of Melbourne.

In Fiji little of such planting has been done, the two outstanding examples being the use of the Weeping Fig tree (*Ficus Benjamina* or *Cunninghamii*) on the water front of Suva, and the Rain tree (*Pithecolobium Saman*) on the road between Lautoka and Natabua. Since 1934 many plantings of other trees have been made along the new King's Road and elsewhere but these have not had time to demonstrate their ornamental value, while the few reservations of natural "bush" made by Government along the King's Road and some portions of the Queen's Road demonstrate the value of mixtures of sundry trees, shrubs &c., in a natural setting for ornamental purposes.

There are, in Fiji, a number of indigenous as well as exotic trees &c., suitable for ornamental purposes, many proving of economic value also, and a list of some such trees is given below together with notes which may prove of general interest and encourage the use of such trees more freely for decorative purposes.

Dealing first with the indigenous trees, by their vernacular names, mention may be made of the following:—

(1) The "Baka"—*Ficus obliqua*, S. A familiar tree as an epiphyte, commonly on the Ivi (*Inocarpus edulis*) which it ultimately destroys by its stranglehold. A windblown specimen of fantastic shape is to be seen near the present Suva Golf Club house, the host having been destroyed. The Baka when grown as a specimen tree develops into a large spreading light shade tree, the small, dark well-spaced green leaves being very attractive, particularly at seeding time when the small red berries appear at the axils of the leaves. An excellent specimen is to be seen near the late Ratu Popi's food garden at Natila, Tailevu Province.

(2) "Cau," "caukuro," "velau"—*Casuarina nodiflora*. A tree common in the bush near Suva, favouring the wet zone as against the dry zone, the latter being preferred by the "nokonoko"—C. *equisetifolia*. As a young tree, the velau, with its bright green needle-like leaves supported on brown limbs, is very attractive, suggesting the European Xmas tree, while as a mature tree, the branches from the main stem suggest a giant candelabra with the "candles" surmounted by dark green dome-shaped hoods. It produces good firewood and makes exceellent fencing posts.

(3) The "Balabala" or tree fern—*Alsophila lunulata*, is a popular feature of the native bush, particularly in the wet zone near gullies and water-

courses. Its growth is vigorous and attractive and makes it a useful ornamental plant when arranged in clumps in places where shady, moist conditions prevail, sheltered from the strong trade winds. Such clumps would beautify many a difficult corner and provide excellent shade for ferns, caladiums, gloxinias, &c. The use of the basal part of the trunk for fern and flower pots is well known and utilised; when split lengthwise, they make excellent non-slip steps.

(4) "Dakua" or Fiji Kauri—*Agathis vitiensis*. A tall stately tree, probably the handsomest tree of Fiji, having a straight smooth stem, carrying a dense head of dark green foliage. It is a slow-growing tree of particular interest in that the seedling, up to about two years of age, carries the typical needle-like coniferous leaf, after which the leaf changes to the broad leaf of the adult tree. Several good specimens are to be seen at the roadside of the Queen's Road between Suva and Navua, but it flourishes best in the hills above 1,500 feet where specimens up to 40 feet in girth may be seen. It produces excellent timber and the famous "kauri" gum.

(5) "Dakua salusalu"—*Podocarpus vitiensis*. A large, erect, handsome tree, carrying small bipinnate leaves, particularly ornamental in the young state. It is fairly common in the bush on the Queen's Road, in the neighbourhood of Mau. The light foliage of the young plants is very attractive, but the tree requires care in transplanting. It produces a very useful soft timber and makes good firewood.

(6) "Dawa"—*Pometia pinnata*. A tall, hansome tree, the new foliage of which is almost blood-red in colour, giving the tree a rather striking appearance. It produces an edible fruit, favoured amongst the Fijians.

(7) "Drala," "Coral Tree"—*Erythrina indica*. A medium-sized quick growing, deciduous tree, which in the dry season—about August—carries clusters of scarlet flowers at the tips of the branches, when bare of leaves, and presents a striking appearance. Other varieties of *Erythrina* are present in the islands, one, a shrub, however, is not so prolific a flower producer as *Erythrina indica*, while the other is favoured for its foliage, having large trifoliate and variegated leaves (*E. variegata*). It is easily propagated by cuttings. Specimens can usually be seen in most Fijian villages and there is one good specimen near the Nasinu stone-crusher.

(8) "Ivi" or "Tahiti Chestnut"—*Inocarpus edulis*. A very familiar tree in Fiji and appreciated for its upright habit, dense, dark green foliage, sweet-scented flowers and fruit—a large nut. It thrives in low-lying places, by the side of creeks and any place that is reasonably moist. It is readily propagated from seed. An excellent specimen may be seen in the Triangle, Suva.

(9) "Kavika"—*Eugenia malaccensis*. A medium to large-sized tree which produces in great profusion crimson to purple flowers along the branches, the stamens of which form a brilliant carpet under the trees as they drop. The fruit is small, loaf-shaped, very juicy but flavourless and carries a large seed.

(10) "Makita"—*Parinarium laurinum*. A medium-sized upright tree with dense, dark green foliage. Produces a nut, the oil of which is used by the Fijian for caulking their canoes, while the foliage makes an excellent thatch for their houses.

(11) "Sa," "saca"—*Parinarium insularum*. A tall tree of upright habit, carrying attractive dark green foliage. Is particularly pleasing when new growth appears, such foliage being of yellowish brown in colour. The timber gives excellent firewood. Good specimens are to be seen at the Nasinu Experimental Station.

(12) " Uto " or Breadfruit—*Artocarpus incisa.* A most hansome broad-leafed tree, familiar to all in these islands, is a fairly quick grower and produces at the ends of the branches one or more large round or ovoid fruits, greenish-yellow in colour. Some varieties carry seed. Propagated by suckers, cuttings and seed.

(13) " Vesi "—*Intsia bijuga,* S. A medium to large sized spreading tree, usually found near water and propagated by seed. It gives excellent shade, fairly dense foliage, bears small purplish-coloured racemes of flowers and produces good timber.

(14) " Vuga "—*Metrosideros polymorpha.* A very handsome foliage tree carrying small dark green and shiny leaves, new growth being a light yellowish green in colour. It is a beautiful sight at flowering time when the exterior of the tree is covered with small scarlet flowers. Good specimen trees may be seen at Colo-i-Suva and generally on the hills.

(15) " Vutu "—*Barringtonia speciosa.* A medium-sized spreading tree with handsome foliage of large shiny dark green leaves. It is particularly suitable for coastal situations where it produces large white pin-cushion flowers, which consist mainly of long white stamens sometimes tinged with pink, followed by a large quadrangular one-seeded fruit. An excellent specimen is to be seen near the Cable Office, Suva.

The following brief list deals with exotic species which have been successfully introduced over a period of years and have proved suitable for local conditions.

(16) Queensland umbrella tree—*Brassaia actinophylla.* A handsome, sparsely branched, evergreen tree, growing about 40 feet high with very large radially divided leaves. The tree is remarkable not only for its foliage but also for the terminal inflorescence which consists of sereval radial spikes of crimson flowers, a great attraction for the native " Kula," or parakeet. It is propagated by seed and suckers. Excellent specimens are to be seen at the Nasinu Experimental Station near Suva.

(17) Rose of Venezuela—*Brownia grandiceps.* As the name implies, this is a native of Venezuela. It is a small tree about 30 feet high, with pinnate drooping leaves which, when young, form flaccid, light brown coloured bundles. A very beautiful tree when in bloom, which at the Nasinu Experimental Station occurs two or three times in a year, the flowers occurring in brick-red clusters along the branches and are sweetly scented. It is propagation by seed.

(18) *Cassias.*—These form a comparatively large and distinguished family:—

*Cassia grandis*—Horse cassia—is distinguished by being deciduous, the pink flowers being produced after the shedding of the leaves and before the new foliage appears. If produces viable seed in Fiji.

*Cassia nodosa* or the pink shower is a more spectacular flowering tree than *Cassia grandis,* the large clusters of apple-blossom pink flowers produced along the branches amongst the foliage being a very beautiful sight. The flowering season is approximately from November to February. The tree does not produce seed in the wet zone but some small success has been achieved with cuttings.

*Cassia fistula,* the Indian Laburnum or golden shower, is another very beautiful Cassia, usually flowering twice a year. A small tree, usually well-shaped and when in flower—from October onwards—is covered with drooping racemes of golden yellow flowers suggestive of the European Laburnum. It does not seed at Nasinu and propagation is by root suckers.

*Cassia siamea, Cassia mulijuga* are two large trees carrying yellow flowers but not so spectacular as *Cassia fistula*, the former non-seeding, the latter seeding freely.

(19) *Coffea liberica.* A small tree with rather large dark green leaves, usually conical in form under open conditions. Its foliage makes it a useful ornamental tree particularly when in bearing, first the small white flowers along the braches, followed by the red berries enclosing the seed. It is both ornamental and useful and is propagated by seed.

(20) Eucalyptus. Several varieties of *Eucalyptus* have been introduced, which after establishment, become fast growers, the trunks and foliage being attractive. *Eucalyptus citriodera* has the additional attraction of being a great favourite at blossom time with the Fijian " Kula " or parakeet.

(21) Flamboyante—*Poinciana regia.* The "flame-tree" of the tropics. a beautiful large spreading tree with feather deciduous foliage. It provides a magnificent sight when in full bloom, the canopy of scarlet flowers overlying the foliage making the tree a most striking object. A beautiful specimen occurs near the Fire Station, Suva. It is propagated by seed.

(22) *Lagerstræmia Flos-reginæ*—Pride of India. A medium to large sized spreading tree, deciduous. The foliage tends to take on autumnal tints. It flowers from December onwards when the tree presents a remarkable sight with its masses of mauve-purple flowers at the ends of the branches. Excellent specimens occur in Government House Grounds, at Nasinu and on and near the Government Station at Naduruloulou.

(23 The Rain Tree—*Pithecolobium Saman.* Two or three varieties of so-called rain trees occur, of which the one named above is probably the most common. It is a large handsome spreading tree, very quick growing and commonly planted for shade purposes at roadsides, open spaces, &c. The best example of roadside planting has already been referred to, namely on the road from Lautoka to Natabua, while as a single specimen the rain tree on the " rara " at Bau Islands is worth noting. Propagation is by seed.

(24 Tulip tree—*Spathodea campanulata.* A tall, erect, quick-growing soft wood tree, with dense foliage. The large scarlet cup-shaped flowers which somewhat resemble the tulip, are carried at the ends of the branches, and when protection is given from strong winds, they occur more evenly over the tree, which provides a striking object when in full bloom. It is propagated from seed or cutting. Excellent specimens occur near the Government Buildings, and in the Department of Agriculture grounds, Suva.

From the foregoing a selection of one or more ornamental trees can be made which will add charm and dignity to the average garden, park, open space or roadside where such is required; further efforts by the Department of Agriculture are in progress to render available constant supplies of planting materials to cope with the horticultural needs of the Colony.

## FIJI KAURI—RANDOM NOTES ON TREES OF FIJI.

By

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FIJI is blessed with a luxuriant vegetation: Nature, in beneficient mood, has indeed provided the forests with many beautiful and valuable timbers. That these timbers have for so long been held in poor regard is attributable to injudicious and wrongful usage rather than to inherent defect or inferiority of quality.

Outstanding among the many varieties of useful commercial timbers is the Kauri and nowhere will more magnificent specimens be found. Known to the native as Dakua Makandre, and to the botanist by the equally formidable but less euphonious title of *Agathis vitiensis*, the Kauri must indeed rank as the most venerable monarch of the local forest.

The timber of the Fijian Kauri is strong and durable, often beautifully grained and varying from the palest of yellow to light amber-brown in colour.

In close proximity grows its ally, the Dakua Salusalu, *Podocarpus vitiensis*, which is of more delicate growth and whose timber when properly dressed reveals a delightful tracery of grain and a finish of almost satiny perfection.

Freely interspersed throughout the forest, may be found the Damanu (*Calophyllum* spp.) or Island Mahogany, rich red in colour but difficult to work; the Kauvula (*Endospermum*) white and clean of texture but of disappointing durability though useful for export fruit packing-cases, and hardwoods like the Buabua (*Guettarda speciosa*), the Vesi (*Intsia bijuga*), the Yasi (*Santalum yasi*), Vuga (*Metrosideros* sp.), the incomparable but rarer Rosawa (*Vitex vitiensis*) and many others, though there are none that serve the every-day demand of man as do the Kauri and Salusalu.

In popular opinion, not only is New Zealand regarded as the home of the Kauri but also as the one country wherein that tree, by virtue of some mysterious susceptibility, can attain to perfection: other countries and climates may perforce produce a hybrid of lesser breed and status—but decidedly not New Zealand Kauri.

Actually, of course, the Kauri tree has a wide distribution and is found in the Straits Settlements, Borneo, Santa Cruz near the Solomon Islands, New Caledonia, New Zealand, Queensland, Fiji and the New Hebrides, so that this tree owes allegiance to no one country or climate.

Certain it is that trees, like denizens of the animal kingdom, are not only influenced but have certain characteristics defined, even modified and varied, by their environment. Thus, Kauri trees rising to maturity in warm temperate climes, growing on not too exposed hill tops, attain a strength, size and durability not found in their kindred, reared and nurtured under easier and less enervating conditions.

In Fiji Kauri, trees are seen growing to perfection in the central hill country beyond Nadarivatu on the island of Viti Levu and the finest specimens occur most commonly at altitudes in excess of 1,500 feet. At this altitude, climatic conditions are by no means dissimilar to those prevalent in the

North Auckland district where the last of the one-time great Kauri Forests of New Zealand alone survive.

So striking is the resemblance borne by the Fijian Kauri to its Maoriland cousin, that there are few who could distinguish any marked difference in the milled product, especially when dressed and polished.

Wandering alone through the forests of the Navai basin—the present centre of the timber industry in this Colony—the uninitiated might easily pass within close range of large, well-developed Kauri trees without discerning them among the tangle of screening undergrowth.

But where a clearing occurs or a break in the canopy of the forest reveals a well defined sky-line, then may the proud head of the Kauri be clearly seen, reared high above the highest of its forest associates.

Clambering up the slopes surrounding Mount Victoria, forest giants may be discovered of immense and satisfying girth, 40 feet and more in circumference: venerable patriarchs that were ancient trees long before George Washington and his legendary axe made history.

Rising to a height proportionate to their girth, these giants rear upwards forty to fifty feet or more of straight clean bole before shooting out the first strong limb to support a massive and ornate head.

Romance attaches to these grandees of the forests; romance associated with the physical history of our world, for these ancients have witnessed changes so remarkable, so obscure, that the accumulated knowledge of man cannot with certainty comprehend them.

Did, perhaps, these forests of Fiji, before being isolated by some immeasurably distant cataclysmal movement, march in uninterrupted column with the Kauri of New Zealand? An interesting if unprofitable speculation this; and yet, who, having viewed the wonders of that deep buried forest at Arapuni revealed only by the force of excavating waters, will deny the possibilities of such fantasy?

But the greatest enemy of the local forest is not flood but fire. The chance ignition of dry undergrowth may cause in a few days destruction of trees which have taken centuries to mature; and what is more serious, the perishing of seed and seedlings in the flames may threaten the total destruction of the stricken forest.

Fortunately, this danger is not an ever present threat in Fiji. The rank and never drying undergrowth, which a well distributed rainfall and even temperature cause to carpet the forests, is Nature's unique protection against the fire menace.

Sheltered beneath the density of this undergrowth, the embryo forest-tree lies dormant in the seed awaiting light and sunshine to prompt germination and release the force of concentrated life.

Without the agency of this light and sunshine, germination is delayed, and, in the gloomy depths of the forest where trees, competing for the vitalising sunshine filter the daylight, regeneration of the forest by natural means is a slow, deferred process.

Modern sylvicultural methods, however, permit the cutting of mature surplus timbers for domestic needs and commercial development whilst providing for the preservation and extension of forests through the medium of natural regeneration. This is aided and encouraged by inexpensive assistance in overcoming competition and by rendering conditions suitable for the proper growth of the desired species.

For the practise of such methods, conditions in Fiji are highly favourable. Subject to conditions laid down by the Conservator of Forests, sawmilling interests carefully cull the large matured marketable trees, cut away epiphytes and clear encroaching or overhanging undergrowth from around seedlings and rising saplings of the valuable species and thus assist them to establish themselves.

Light and penetrating sunshine contribute to the work of restoration and regeneration so that where but one tree grow before the future should see many.

The devastating practice, prevalent in many countries, of denuding the hills of vegetation has been avoided in the central highlands of Fiji, making possible the preservation of timber-supplies for future generations. Unfortunately, in the more accessible coastal areas denudation has left its mark, especially in the dry zones. Here fires are of frequent occurrence and much wastage of timber and of land has resulted. But of recent years serious attention has been directed to the potentialities of timber as a secondary industry and it is hoped that such further losses will be avoided and that development of forests will become a permanent policy.

Local opinion, which for years pronounced the Fijian timbers to be of a quality inferior to those produced in other countries, is not now so vociferous in condemnation, and the time will surely arrive when a proper pride will be evinced in yet another product of this beautiful and fertile land.

In the early days of the industry no doubt this prejudice was prompted by the supply of badly cut, badly classified and probably immature timber. The introduction of modern plant and the application of up-to-date methods of manufacture have improved the quality of the marketable article and succeeded in demonstrating that, grade for grade, local timbers compare in every respect with those imported, with the result that this industry is rapidly approaching a stage when it will assume an important part in the economic life of the Colony.

The timber industry of the future will provide work for the European and Native alike, and thus introduce into a new land a calling of ancient and honorable lineage—the Craft of the Woodsman.

## CITRUS DISEASES IN FIJI.

By

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DURING recent years there has been some development of Citrus growing in the Colony and several small commercial orchards have been established. In addition there are many trees cultivated by individuals for private use; besides those growing in a more or less natural state on native owned lands and in the vicinity of native villages.

The total export of Citrus in 1937 was 8,324 cases of mandarins, grapefruit and oranges. In view of the increasing interest shewn in this crop and the possibility of an extension of block planting, a record of diseases and their control is being made. One of the great features of the Citrus tree is its comparative freedom from fungus diseases. Fiji is particularly fortunate also in that the most serious diseases, Canker and Black Spot are not present. The troubles discussed below, however, are not uncommon and may cause considerable damage—both by interfering with normal growth and by reducing yield.

### 1.—MOTTLE LEAF OR FOLIOCELLOSIS.

This disease derives its name from the appearance of the leaves, but it also affects the development of the fruit and the growth of the whole tree. The leaves show chlorotic areas irregular in outline, situated between the main lateral veins on each side of the midribs. Normal, fully-developed leaves may show the condition but, commonly, affected leaves are small and stunted; the fruit is usually very small and " die back " of twigs and a bushy type of growth occur.

The causes are not fully known. It has been suggested that the trouble may be associated with calcium deficiency, with excessively high salt content of the soil and the presence of heavy root infestation by the citrus nematode (*Tylenchulus semipenetrans*). It is generally regarded as a physiological disease and is common on light sandy soils.

Locally, affected trees have been predominantly Grape fruit and in one case the trees were also suffering severely from Collar-rot.

*Control.*—In several Citrus growing countries the use of zinc sulphate spray as a corrective for mottle-leaf has proved so successful as to be generally recommended and in local trials this treatment has been used with good effect.

Solutions of zinc sulphate (10 lb to 100 gallons water) with Agral 1 (0·15 per cent. solution) as a spreader have proved useful—when used at the rate of 2–3 gallons per tree. The spray should be applied at the dormant period in the growth of the tree.

2. A similar spray composed of 10lb zinc sulphate, 5 lb hydrated lime, 8 to 10 ozs. spreader and 100 gallons water has been used in South Africa at a cost of from 1½ to 3d. per tree according to size. Trees showing 55 per cent. mottling were restored to health in a few months and the beneficial effects may be expected to last two years.

Applications of zinc sulphate direct to the soil at the rate of 8 lb per tree placed in a narrow circular furrow 18 to 24 inches from the trunk and covered with soil have also been recommended but no trials have been made locally. Broadcasting zinc sulphate beneath the trees has been stated to be ineffective(1).

It is also advisable to promote vigorous growth of the trees by applications of lime, compost or suitable fertilizers.

### 2.—COLLAR ROT OR FOOT ROT.

This disease is also known as Bark-rot or gummosis and is widely spread, occurring in all citrus-growing countries. The cause is still obscure, although in India, North America and the West Indies it has been shown to be due to *Phytophthora parasitica*, a soil fungus.

In Fiji it has been noted where citrus stock has been budded low down and more particularly on sweet orange stock than on Seville orange.

The disease develops at ground level and rapidly spreads, rotting the bark and ring-barking the tree: decay spreads to the roots and in many cases such root-rotting fungi as *Polyporus* sp. and *Schizophyllum commune* gain entry and completely destroy the root system. In dry weather an exudation of gum may be seen.

In most cases the disease has been well advanced before discovered and so treatment was practically impossible. Occasionally such trees are considered worth saving and inarching has been practised with some success. For this, young Seville orange seedlings 18 months to two years old have been planted about the base of the affected tree and after they have become established are grafted into the healthy stem of the tree above the infected parts.

The main tree has to be cut back severely in order not to put too heavy a drain on the young seedlings which gradually take the place of the dying roots of the trees and subsequently form a new root system. The diseased parts should be cut back to the healthy wood, sterilized and painted with coal-tar.

Seville orange seedlings are used as they are particularly resistant to this disease and in Fiji appear to be the most robust stock for such a purpose. Until the inarched seedlings have grown sufficiently to maintain the branch system of the trees, judicious pruning is necessary and all fruits forming should be removed.

### 3.—BARK-CRACK.

A somewhat similar disease to Collar rot is a form of Gummosis which causes the bark of stem and main branches to crack and peel off. In dry weather copious gumming accompanies the condition but in the wet zone this gum is not often seen as it is very soluble in water and readily washed off by rain.

The condition occurs on all varieties but most commonly on grapefruit and may be serious enough to destroy large branches, owing to the complete lifting of the bark.

In 1936 many cases of this trouble were successfully treated as follows:—

The diseased bark and wood were cut back with a sharp knife which was sterilized frequently by dipping in alcohol and flaming. The cuts so made,

some being very extensive, were then soaked with the following sterilizing solution:—

| | |
|---|---|
| Hydrochloric acid (conc.) | .. 15 cc. |
| Mercuric chloride . .. | .. 1 gram. |
| Water .. .. .. | .. 1,000 cc. |

and later painted over with coal-tar.

The sterilizing solution used is stated by Cunningham (2) to have good penetrating properties and the usefulness of the treatment was fully demonstrated by the complete healing of the wounds and the recovery of all trees treated.

Considerable damage to stems and branches of trees is frequently caused by cultivating implements. If not attended to such wounds form zones of entry for various organisms which cause disease and death of those parts.

All such wounds should be treated in the way described and in an extremely short time will be found to have healed completely.

The solution and the coal-tar paint are always valuable at pruning time to treat all cut ends of lower branches.

### 4.—SOOTY MOULD (*Capnodium citricolum* McAlpine).

The superficial black blotches on branches, leaves and fruit caused by this fungus are very well known and in many cases spoil the appearance of the fruit of oranges, lemons and mandarins. The casual fungus is not a parasite and does not penetrate the tissues of the plant. It merely lives saprophytically on the honey dew exuded by certain scale insects which may be found in great numbers on all parts of unsprayed Citrus trees.

The Sooty-mould may be removed temporarily by spraying with a fungicide as Lime Sulphur or Bordeaux Mixture but a more permanent control aims at the removal of the scale insect which is primarily responsible. This may be achieved by using a combined spray as follows:—

Bordeaux 3–4–50 + Oil Emulsion 3 quarts applied at blossom fall; and in some cases an additional application of Red Oil, 1 part to 60 parts water, is beneficial.

Fruits disfigured by the black growths of mould may be cleansed by immersing them for one minute in a solution of Boracic acid, ½ lb and Chloride of Lime ½ lb to one gallon of water. The fruit should then be washed well in clean water and dried thoroughly

### 5.—VERRUCOSIS OR CITRUS-SCAB. (*Sporotrichum citri* Butler).

This disease is extremely common on the rough lemon throughout Fiji and is the cause of the characteristically deformed leaves and fruit.

On young leaves and twigs it forms extensive corky lesions or blisters and often completely deforms and disfigures the fruit. Leaves are susceptible to infection only when less than 15mm. wide and fruits are immune after they have attained a diameter of 20mm.

The casual fungus develops rapidly in moist conditions and may be controlled by spraying with Bordeaux Mixture 3–4–50 or Shirlan A.G. outdoor strength—preferably after pruning and before new growth takes place.

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## POISONOUS PLANTS OF FIJI.

By
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IT is generally considered that among the plants formerly used by the Fijians for medicinal and other less-worthy purposes were many possessing poisonous principles, but certain knowledge of these is very limited and at the present time reliable information is obtained only with difficulty.

Among the poisonous plants recorded by Seemann (1865) are:—

*Antiaris Bennettic* Seem., " Mavu-ni-Toga "—Arrow poison.
*Oncocarpus vitiensis* A. Gray, " Kau-Karo "—" Itch wood."
*Excœcaria agallocha* Linn. " Sinugaga "—Poisonous sap.
*Barringtonia speciosa* Linn. " Vuturakaraka "—Fish poison.
*Derris uliginosa* Benth., " Duva "—Fish poison.

There is no information regarding the possible use of these plants in native toxicology or medicine. They are all common and their properties and uses are fairly obvious and widely known to the Fijians. Of the real or fancied properties both of the many plants used by native herbalists in treating their patients and of those used in the practice of " Draunikau " (witch craft) it may be said that nothing is known.

The latter use is now very rare although its suppression does not appear to have diminished either its physical or pychological effect upon the unfortunate victim in such cases which do occasionally occur. That actual poisons are frequently used has always been suspected and it is therefore of interest to record the identification of even one such plant.

During 1936, in the course of the hearing of a case of witchcraft on Vanua Levu Island, reference was made by witnesses to three plants, Yaro, Baka and Makanavanava as the source of the ingredients used.

The first two, namely *Premna taitensis* and *Ficus obliqua*, are common trees throughout Fiji, but the last named appeared less known. " Yaro " bark occurs in the recognised Materia medica of Fiji, being occasionally exported along with " Toga " Vine (*Rœphidophora vitiensis*) to America for use in the manufacture of a proprietary nerve tonic, while " Baka " bark might be expected to have astringent properties.

After careful enquiry the reported name Makanavanua was identified with Manaivanua, a tree known to be poisonous and to be used in the practice of " Draunikau."

Specimens of " Manaivanua " have recently been collected and found to be *Excœcaria acuminata* Gillespie, belonging to an extremely poisonous genus known in Australia, Fiji and Polynesia for its dangerous properties. The tree is described by Gillespie (1932) as follows:—

> "A small, glabrous tree, the branchlets slender, gray, striate, somewhat flexuous. Leaves alternate, 5·5–13 cm. long, 2–4·5 c.m broad; blades entire, pale-green, slightly shining above, dull beneath, thinly chartaceous, elliptic to ovate, apex acuminate, the tip rounded, base acute to obtuse, lateral nerves slender, nearly straight, anastomosing with an inframarginal nerve, veinlets obscure; petioles slender, 1–2 cm. long. Inflorescences spicate, occasionally once or twice forked from the base, 1–2 cm. long; female flowers 1 or 2 at the base of the male spike, or borne separately subsessile on short racemes. Bracts of the

male flowers densely imbricate, almost as wide as the spike, rounded, crenulate, minutely cuspidate at the apex; perianth segements (3) lanceolate, shorter than the 2 or 3 stamens, often laciniate near the base. Female flowers about 3 mm. long, the perianth-segments triangular, ovate, crenate-ciliate nearly equalling the globose ovary; stylar column distinct nearly 1 mm. long, the lobes acuminate, recurved. Capsule about 12 mm. long, 16 mm. broad, the valves woody; seeds subglobose, brown, more or less lined and spotted, about 5 mm. in diameter."

Gillespie records this tree from Namosi and Nadarivatu in Viti Levu so that the present record extends its known range to Vanua Levu.

## FIELD NOTES ON COTTON GROWING IN FIJI.

By

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Agricultural Officer East.

FOR a number of years now the Department of Agriculture has been interested in stimulating the growing of cotton as an export crop with an assured market. This interest has included all aspects from breeding and selection work to the growing of the commercial crop, and its ginning and marketing.

Close contact has been maintained at all times with the private growers. This year it has been possible to offer a slight increase in price for seed cotton and cotton planting is likely to cover a wider range in these Islands. Therefore it may be of interest to note a few of the results of practical experience in the field.

To commence with the seed: it is of common occurrence for one to be asked why other varieties are not tried and why a strict control of seed supply is held. The answer is that a very complete assortment of varieties has been tested under Fiji conditions and the types now being encouraged by the Department of Agriculture are the best for local conditions. The value of cotton depends to a high degree on its uniformity, and this depends principally on the purity of any one strain. Continuous selection work is being carried out by the Department and great harm would be done if, as the writer remembers finding, a grower had obtained seed of another variety and had put a neat border of this around his commercial plot of cotton.

The cotton plant suffers from a reputation for hardiness so that any soil is regarded as suitable. Sown in the right season cotton will do surprisingly well on poor soils but a large number of the present growers plant cotton as as afterthought after rice-planting is over, and therefore too late. Even then a greater yield per acre is expected than is the average in many cotton-growing countries.

The three major soil problems met with have been:—

(*a*) Some deep black soils have a deleterious effect on the germinating seed which requires much re-supplying.

(*b*) Some soils have a tendency to cake hard on the surface after rain. Indians may be seen prising off the caked earth from the struggling seeds, but a more practical method is to sow 6 to 10 seeds at each hole. Those burst out by force of numbers and the rest is the survival of the fittest.

(*c*) Many soils on hill-slopes when cultivated are very subject to erosion under normal rainfall. Many complaints are made that the cotton has been washed out when all that is required is sowing on ridges and perhaps the protection of the plot by a small drain on the upper side.

Given a reasonably well prepared seed-bed the maintenance of cotton in Fiji resolves itself into a little weeding and thinning-out until the plants meet to form a canopy over the earth and perhaps one weeding before harvest to facilitate picking. The plant is intolerant of wet, so reasonable care should be taken to avoid planting where exposed to seepage or excess surface-water. There is also a tendency to space the cotton too widely in sowing the seed and while 3 ft. x 6 ft. spacing is generally adaptable, in poor soil this distance can usefully be reduced to 3 ft. x 4 ft.

The picking is an important factor and acreage is strictly limited by the assured pickers available. About two pickers can comfortably attend to one acre.

A very sore point with growers has been the labour entailed in picking over the seed-cotton to sort it into grades. Undue picking-over is also a complaint of the buyer who has to deal with a lot of twisted cotton mixed with broken leaf. The solution is to pick clean in the field and it is recommended that two bags should be used, one for the obviously clean and the other for doubtful product. A good picker can by this system reduce "picking-over" to the pleasant task of picking out clean seed-cotton from the doubtful heap to add to the first grade.

The above are a few notes which may prove useful to the grower of what can be a profitable and pleasing minor crop. The scarcity of labour will prevent cotton being a plantation crop in Fiji, but it certainly has a future as a smallholder's crop and as a very useful rotation crop or even in mixed cultivation. The moderate returns last season will, it is considered, materially stimulate this crop in the next few years.

## NOTES ON THE CULTIVATION OF EUROPEAN VEGETABLES IN FIJI.

By

H. W. SIMMONDS, O.B.E.,

and

D. A. DONALD, H.D.A.

It has now been shown that in the soil in many parts of the world there is a definite deficiency of certain essential minerals, either actually or in a form available for plant-food, and this deficiency is reflected, not only in the growth but in the actual mineral contents of the resultant herbage.

This mineral deficiency in the herbage is further reflected in the low percentage of " solids-not-fat " in some milks whilst in human beings it shows as a liability to boils, tropical sores, ulcers and in the early decay of teeth. It follows therefore, that a supply of dietically complete vegetables is an absolute essential to human health in the tropics, as elsewhere, both for mineral and necessary vitamin contents.

In the humid tropics the difficulty of supplying such high grade vegetation is greatly increased by the heavy rainfall, which by leaching out the soluble nitrates and lime causes an acid condition of the soil in which such phosphates as are present may be locked up in a form unavailable as plant-food, as also, may the potash.

Formerly and to some extent still, the Fijian natives unconsciously overcame the insufficiency by eating quantities of fish and seaweed which are rich in mineral salts. It is to be deplored that, even in small islands, so much tinned fish is now consumed and it is suggested that efforts might be made by local merchants to supply the natives with salted fish in place of the tinned article.

### THE VEGETABLE GARDENS.

In the formation of a vegetable garden designed to supply these dietetic deficiencies the first consideration is the construction of a compost heap, in order to replace those organic elements of the soil leached out by rain or removed as crop or weeds. Such organic material is also of the utmost value in improving the texture and water-holding capacity of the land. There are various ways in which such compost heaps can be made. In the wet climate of Suva a heap of grass cuttings, leaves, peelings, &c., mixed occasionally with a little soil serves the purpose. After about four weeks it is turned over and tramped down and further additions of grass, leaf, &c., are made. About four weeks later it is again turned over, tramped down and covered with about four inches of soil, after which cucumbers or rock melons can be planted on top and a new heap commenced. In this way no space is wasted and by the time the crop is finished the heap has generally rotted sufficiently to be incorporated in the soil.

Where climatic conditions are drier the compost is best made in a shallow pit since it is essential that the heap should be kept moist, and, in all cases, the addition of a certain amount of cow or horse droppings is advantageous in hastening the decomposition.

### DRAINAGE.

Care should be taken where the land slopes to prevent soil-wash by making contour drains and not the straight up and down ones which are so commonly seen. Also, to prevent erosion on sloping hill-sides under the conditions of tropical rainfall, terraces should be constructed to follow the contour of the

slope. In successful vegetable production it is essential that steady, continuous growth of the plant be maintained. So that, having secured good soil and arranged for an adequate supply of organic and inorganic plant-food constitutents, attention must be paid to the regular supply of sufficient water. Even with the copious rainfall of Suva watering is frequently necessary as is the provision of suitable drainage, since the free movement of the soil-water causes proper aeration and promotes the availability of plant foods.

### MANURING AND LIMING.

As stated above, many tropical soils are deficient in necessary minerals or, if such are present, they are in a form when they are not available to the plant. Many of the soils also are distinctly on the acid side rendering liming necessary and this is always so with the red lateritic types so common in the tropics. In this last case the use of coral sand (95 per cent. calcium carbonate) is probably the best method of applying the lime, its action being much more prolonged, whilst it also tends to improve the texture of such soils.

The use of some form of phosphate is also generally necessary and this can be applied either as basic slag, which is slow in action, or as the quicker-acting superphosphate. It must be remembered however, that if the latter is used continuously it will tend to increase acidity and additional liming may be required. The soapstone rocks of the Suva district have been shown to be rich in potash and lime and, where these are incorporated in the soil in quantity liming should not be necessary. In other districts however, the addition of potash is likely to give useful results.

### PLANTING METHODS.

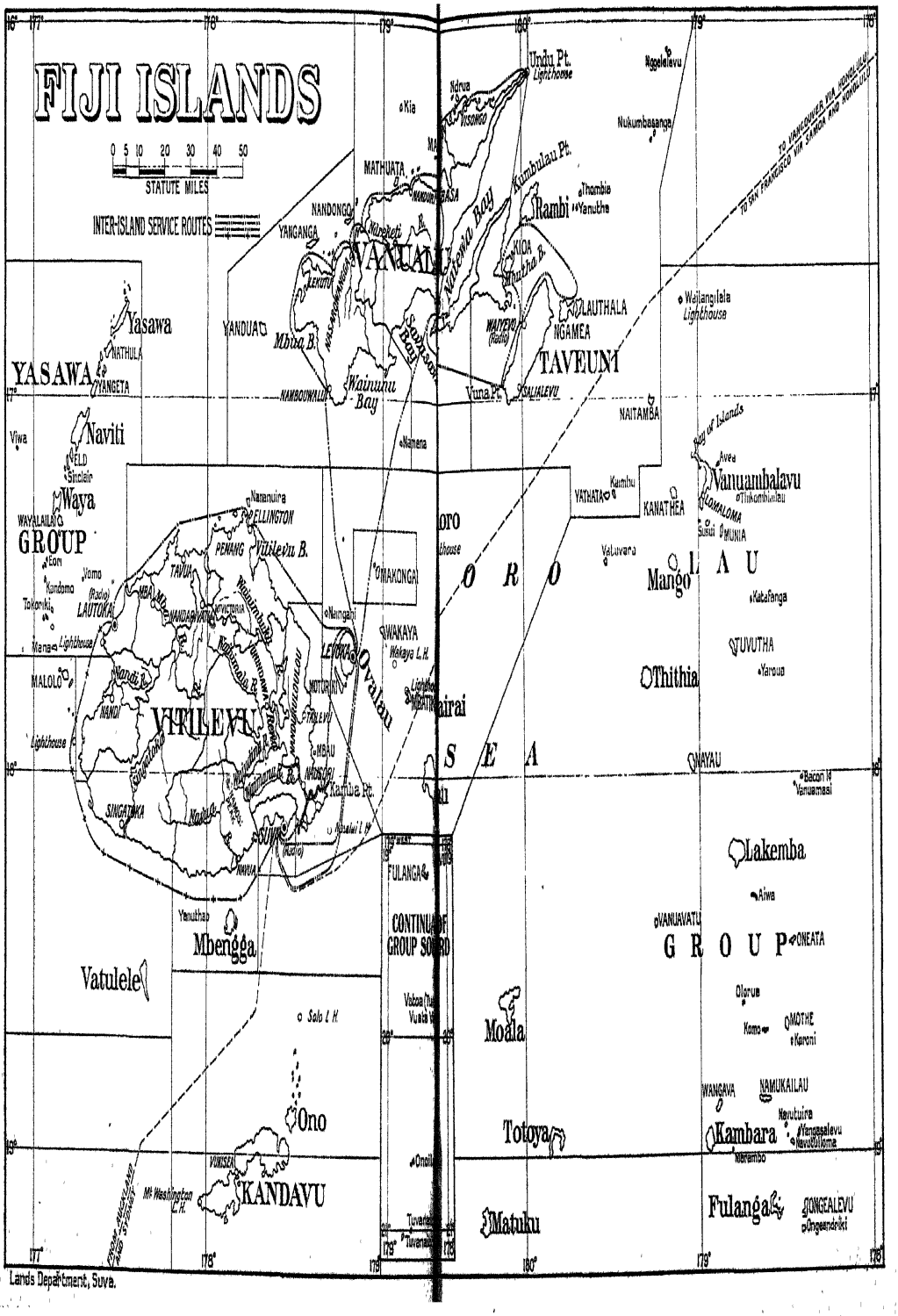
*Beans (French).*—These can be grown throughout the year except in periods of continuous rain, and they form a great standby in the tropics. They are sown directly into the ground but can be transplanted, in wet weather, if required. They are subject to root disease and such diseased plants should be pulled up and burnt.

In Fiji the usual variety grown is Canadian Wonder, which does remarkably well. " Burpee's Stringlers " gives perhaps a more tender bean and comes into bearing earlier. It does not, however, crop so heavily, whilst the vine is extremely brittle. Two other food varieties are Sutton's " Premier " and Sutton's " Golden Waxpod," the latter producing a wonderfully even crop. Of the climbing varieties " Epicure " grows well but the crop produced is not great.

*Beet.*—These cannot be said to do well on the Suva soapstone. This is partly due to the destruction of the seed, when planted in the open, by some agency, probably millipedes and largely to foliage destruction by the larvae of the Pyralid moth, *Hymenia fascialis*. No doubt these latter could be controlled by dusting with pyrethrum powder and a trial might be worth while. Excellent beet can be grown on the volcanic soils of Taveuni, where, although *Hymenia* is present, it seems to be largely controlled by an *Apanteles* parasite.

*Beet Silver.*—This grows excellently but the foliage is soon skeletonised by the larvæ of the abovementioned moth.

*Cabbage (English).*—English cabbage as a rule grows well in the cooler season of the year. The seedlings should be treated as described for cauliflower below. Any early variety, such as early " St. John's Day," " Early Drumhead " or " Succession " can be used. The last named, however, does




Lands Department, Suva.

not stand so well after hearting as the others. Sutton's "Pride of India" in sweetness, tenderness and ability to stand after hearting has been found the most successful. Cabbages can be grown from the slips which form after the head has been cut. These slips are said to heart with greater certainty but, the writers have not used this method so far.

*Cabbage (Chinese).*—This can be grown throughout the year, requiring similar treatment to English cabbage. Under dry conditions it requires water or otherwise will show a tendency to run to early flowers.

*Cauliflowers.*—Cauliflower is now grown regularly in the tropics, using Indian raised seed. It requires good soil and regular application of liquid manure. The seed may be sown broadcast, in a well prepared bed or in a seed-box. When two to three inches high the plants should be transplanted into rows six inches by six inches. When about six inches high they should be planted out into rows two feet by two feet apart. On the dry side of Fiji, Sutton's "Early Market" has proved a good variety, whilst in the Suva district Sutton's "Benares Main Crop" has given the best results.

Cabbages and cauliflowers suffer from the attacks of cutworms at times, whilst the small cabbage moth, *Plutella maculipennis*, sometimes ruins a crop. Dusting with pyrethrum should control the latter, but poison baits are the only satisfactory methods of dealing with cut worms.

*Carrots.*—This vegetable can be grown throughout the year. It requires a light soil and the seed must be sown directly into the ground as the young seedlings will not transplant satisfactorily. They should be thinned out to about two inches apart and when the roots are about half grown they can be thinned again, and eaten.

When small the sedlings require a certain amount of shade on hot, sunny days.

*Corn (table).*—Ordinary sweet corn does not generally do well in the tropics. A hybrid Sweet x Guam White obtained from Hawaii has, however, given excellent results in Fiji. A Puerto Rico selection from the hard type has also done well: it is not so sweet as the preceding hybrid but the cobs are well filled and tender and the plant seems more resistant to disease. It is however, taller and more liable to damage by wind.

Corn can be grown throughout the year, providing it gets sufficient moisture. It requires good soil and is planted two seeds to a hill about three feet apart, in rows about four feet apart. In Suva, superphosphate applied when planting followed by a little sulphate of ammonia when the plants are about six inches high, gives satisfactory results.

*Cucumbers.*—These can be grown anywhere, at any time, but, as stated above, form a useful cover to the compost heap. They do not transplant well, so must be sown directly into the soil and thinned out to two or three plants to a clump, each clump being about six feet apart. The plants require an abundance of water and liquid manure. Anderson's "Commercial" has proved a satisfactory variety in Suva, but most growers save their own seed from their best plants.

*Endive.*—For those who like it, this salad can be grown throughout the year. Treatment is similar to lettuce and is detailed below.

*Lettuce.*—The small "mignonette" variety of lettuce can, with care, be grown in Fiji throughout the year. The larger types of cabbage lettuce often do well in the dry season.

In the cool season lettuce can be sown openly in good soil which has been top-dressed with superphosphate and shaded until the plants form their second pair of true leaves. They should then be thinned out to nine inches apart and some transplanted elsewhere. A good situation is between two rows of corn which will provide some shade.

In the wet season more care is required and a good plan is to sow the seed in tins and transplant when in the first cotyledon leaf-stage into other tins, placing the young seedlings about three inches apart. When the young plants have formed a good root-system and are about three inches high, they can be put out into well-prepared ground, choosing an overcast day if possible, and disturbing the roots as little as possible. Some temporary shade is generally required, but lettuces require plenty of light and water. Two or three waterings with weak sulphate of ammonia, especially in dry weather, greatly improves the growth and quality of this and all green vegetables.

*Melons (Rock).*—These require very rich soil and, like cucumbers, do well on a compost heap. They should be treated exactly like cucumbers, but require more manure. The ripening fruit is very liable to sun-scald and should be shaded when it approaches maturity. Anderson's " Emerald Gem " has given excellent quality fruit, whilst many of the large varieties do well, but give fewer fruits.

*Peas.*—These are difficult to grow on the wet side, but Yorkshire " Hero " sometimes gives a good crop. In the dry zone they do much better and Sutton's " Matchless " and " Best of All " have given very promising results. Peas require good soil with plenty of humus, but if the compost has only recently been dug in the millepedes play havoc with the seeds. A reserve can, however, be planted in tins, as they transplant well when small.

*Potatoes (English).*—These can be grown in the cool season on the dry zone. They require good soil.

*Tomatoes.*—Tomatoes in Fiji, as elsewhere, are subject to a number of diseases, the most disastrous of which is bacterial wilt. No definitely resistant strains to this disease are known, although the small feral cherry tomato sometimes grows well on land known to be affected with the bacillus.

Various methods to guard against this trouble have been tried including sulphuring the soil, also growing the plants in pure broken well-weathered soapstone which proved successful, and gave an excellent crop. Another method tried was to sow the seed at stake to avoid root damage when transplanting but although good results were obtained control plantings did not indicate that these results were due to the method. One plant, however, grown on soil known to be affected, has twice developed every symptom of the disease and twice recovered. Seed from this plant is being saved for further trials. Generally speaking, the trouble is prevalent in warm wet seasons, but diminishes in cool dry weather. Of various varieties tried, Sutton's " Best of All " has given good crops of small, high quality fruit and this firm's " Golden Perfection " produced a beautiful fruit of larger size. " Stone " is another variety of the highest quality and of good size, whilst " Kondine Red " was excellent, but smaller and somewhat more susceptible to wilt. " Maryglobe " also produces good yields of medium-sized fruit of good appearance, suitable for export. " Burwood Prize " in the Suva district proved a very poor fruiter on each occasion when tried.

*Spinach (N.Z.).*—The seed of this useful vegetable is irregular and slow in germinating. This difficulty can be largely overcome, however, by immersing in very hot water for a minute or so just prior to planting, which should be done in a tin or warm, moist bed. Each seed has several embryos and may produce as many as six plants. These should be pricked off when still in the first leaf and planted out into good soil after the second or third pair of true leaves appear. The plant produces a number of crops of excellent quality, four or five plants yielding sufficient for a meal for four persons.

## A PRELIMINARY NOTE ON LARVAL PARASITES OF THE SPIKE MOTH IN TAVEUNI ISLANDS.

By

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DURING the years 1930 to 1933, no less than four parasites (egg, larval and pupal) of *Tirathaba rufivena* Walk., were introduced from Java into Fiji against the local *T. trichogramma* Meyr., which has five native parasites. Paine, who made most of the liberations, wrote (1) in 1934 " if, during the next few year *Apanteles* " (a Braconid parasite) " does not show a much increased population at Mua or Vuna on Taveuni, it will have to be regarded as a relatively unimportant enemy of *T. trichogramma* as in these places *Apanteles* is still extremely scarce."

During October, 1937, the writer made a short visit to Mua Estate and collected *Tirathaba* larvæ of all stages. These have been reared to adults in the laboratory in Suva and gave the percentage parasitism as in the following table. (The number of larvæ used for the percentage parasitism of *Apanteles* and *Nemeritis* is different from that for the other parasite as more than half-grown larvæ must be ignored. This is because they have already escaped parasitism which can only befall them during stages prior to the fifth or last instar). The egg parasite *Telenomus tirathabæ* Ferr., is not included.

| Parasite. | Description. | Percentage parasitism. | No. of larvæ examined. |
|---|---|---|---|
| *Apanteles* | Small black Braconid, 3 mm. in length .. .. .. | 2·5 | 165 |
| *Nemeritis* | Black and orange Ichneumonid, 10 mm. in length. .. | 0·8 | 165 |
| *Erycia* | Squat fly. Grey body, orange patch at base of wing. 7–8 mm. in length .. .. .. .. .. | 41 | 185 |

It is realised that larger numbers of larvæ will have to be bred before significant data can be obtained but the abundance of these pests, despite the very satisfactory control by the Tachinid *Erycia*, shows that they are not yet under close control on certain portions of Taveuni despite seven years during which the parasites have had time to become established. In 1931 (1) the author suggested that the scarcity of *Apanteles* might be due to a rapid spread over the island from the original point of liberation. This seems borne out by Paine who shows (1) that it was more abundant in the north at Nacaugai, where no parasites were liberated, than at Mua and Vuna where they were; in fact, during September, 1934, the percentage parasitism at Mua was nil.

Since Paine's paper, additions have to be made to the local parasites of *Tirathaba* which now are known to be five in number, viz:—

1. *Trichogrammatoidea nana* Zehnt.—A very minute egg-parasite whose effect is stated by Taylor (3) to be negligible.

2. *Meterorus trichogrammæ*, Wilk.—A brown Braconid 4 mm. long regarded by Taylor as of little value as a control against the larvæ.

3. *Echthromorpha immaculata* Krieg. (Formerly referred to as *E. diversor* Morley).—A large Ichneumonid 15 mm. long, orange and black in colour. According to Taylor its parasitism of the pupæ does not exceed 3 per cent.

4. *E. tirathabæ* Perk.—Like the preceding but with a marked difference in size between the sexes, the female being 13 mm. long and the male only 7 mm. Bred from pupæ (?) by Taylor and Paine from Taveuni.

5. *Antrocephalus renalis* Waterst.—This black Chalcid pupal parasite has a large range in size, females from 4·5 to 8 mm. and the male from 5 to 6 mm. First specimens in Fiji bred by the writer in February, 1931, but previously recorded from Java by Paine.

(1) Paine, R. W., 1935. Department of Agriculture, Fiji, *Bulletin* No. 18.
(1) Lever, R. J. A. W., 1931. Department of Agriculture, *Agricultural Journal*, Vol. 4., No. 2.
(3) Taylor, T. H. C., 1930. Department of Agriculture, Fiji, *Bulletin* No. 17.

## HINTS ON COLLECTING AND FORWARDING OF INSECTS.

By

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Government Entomologist.

PLANTERS, and other settlers who live away from the vicinity of Suva, wishing to send to the Department of Agriculture specimens of insects damaging their crops or garden plants may find the following information of some use. It is hoped that by its means the material sent may arrive at headquarters in the best condition for examination.

Live insects, such as caterpillars, require both sufficient food and ventilation. The food-plant should be so packed that there is no chance of water leaking from the receptable holding it while adequate ventilation can be obtained by boring holes in the box or tin if wire gauze cannot be used. Closed tins without some form of ventilation result in fermentation or condensation and this will spoil the contents. A label with " live insects, immediate delivery," should be affixed. For very short journeys there is clearly less need to take such precautions.

Delicate insects such as aphids, thrips, lice, ants and small flies should be put in small tubes or bottles of methylated spirits, formalin or alcohol. Harder and more robust insects such as beetles, bees and wasps may be packed in tins with carbolic acid or powdered camphor-balls and fine sawdust or cotton wool to prevent injury.

Butterflies are best sent by placing them within rectangular pieces of smooth paper which have been cross-folded into the shape of a triangle and the overlapping edges turned down.

Scale insects should be kept on the leaf which is then pressed between blotting paper under a heavy weight.

Large moths, stick-insects and grasshoppers should have their viscera removed with a pair of fine scissors and the abdomen filled with cotton wool.

Attention should also be given to packing as violent jarring may be expected on a journey in small cutters or schooners—corrugated cardboard and " wood wool " are two of the best substances as shock-absorbers.

While the material is being kept preparatory to shipment it is important to place it out of the reach of ants which in an hour or two may damage the whole collection and make it useless.

Accompanying the specimens should be the name of the crop attacked, particulars of the portion so attacked and its age with the date and exact locality. If possible, samples of the damaged tissue should also be sent or a rough sketch if this is impossible.

## THE GIANT TOAD.

By
R. J. A. W. LEVER.

THROUGH the kindness of Mr. H. W. Simmonds, O.B.E., a dead toad, *Bufo marinus* (L.), was forwarded early in November to the writer's laboratory for scrutiny. The amphibian was found at the point of death in association with two others which were mating and are believed to have killed it.
A post-mortem examination showed the specimen to be an immature female. The stomach-contents revealed the following:—

14 slugs—1 large.
9 millipedes (8 red and 1 grey).
1 small univalve shell of a kind eaten by mynah birds.
Fragment of pond-weed and leaves.
1 piece of wood, ¾ of an inch long of the diameter of a cheroot.

The most interesting point in the above is the addition of millipedes to the diet as it has been shown previously (1) (2) that the red millipede was rejected when fed to this toad in the laboratory. Fragments of other millipedes were also present in the stomach and the contents of the intestine showed invertebrate remains but these were in too advanced a stage of digestion to permit of identification. In Jamaica millipedes are frequently eaten and one would therefore expect them to be attacked elsewhere.

A colony of tadpoles of this toad was released by the writer at Navua in September and adults have also been forwarded to Taveuni Island where tadpoles were first sent in May of this year.

The toad family is known to have a milky secretion from certain skin glands whose effect on the heart and central nervous system may be severe. It is interesting to record local cases of poisoning of young fox terrier dogs which have attacked *B. marinus* in Suva. The symptoms shown were dilated pupils, tetanic spasms and copious salivation. The animals responded to treatment by the Veterinary Division.

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(1) Simmonds, H. W., 1937. Proceedings Royal Entomological Society, London. Vol. 12, Pts. 4–6.
(2) Simmonds, H. W., 1937. Ann. Bull. Divisl. Reports for 1936, Fiji.

## VETERINARY NOTES.

By

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Senior Veterinary Officer.

### PROGRESS IN TUBERCULOSIS ERADICATION.

PRIOR to 1931 five dairy herds in Suva had been rendered free of tuberculosis by means of the tuberculin test. The test used in those days was the subcutaneous test with which many dairy farmers are familiar. The application of this test was a tedious affair, necessitating frequent visits to the dairy and numerous readings of the thermometer, since the test depended on the temperature reaction of the cow following the injection of the tuberculin.

In 1931 the Veterinary Division commenced to use the recently introduced double intradermal tuberculin test. In this test concentrated tuberculin is injected in minute quantities actually into the skin, care being taken that the dose does not penetrate into the tissues underneath the skin. The decision as to whether the animal is tubercular or not is derived by judgment of the reaction which occurred in the skin surroundings the site of the inoculation. Whereas the subcutaneous test could be performed within a 24-hour period, the intradermal test requires a period of 72 hours for the completion of the test. In the former case however, owing to the frequent visits and attendance on the cattle (6 visits within the 24 hours) it was not a convenient test for the officer to perform when he has numerous other duties. In this case of the intradermal test three visits only are made, with an interval of 48 hours between the first two and 24 hours between the second and third visits. For an accurate reading of the test one is not bound by the necessity for exact punctuality, and the visits can be made at convenient hours to suit both the farmer and the veterinarian. It is seen from this that the test is a more convenient one for all concerned and the introduction of this test has enabled marked progress to be made in the eradication of tuberculosis by tuberculin testing during the last 6 years.

As before mentioned, five herds were entirely free from the disease in 1931 and at that time the total incidence of tuberculosis in herds under test was slightly over 18 per cent. By 1935 twenty herds in the Suva district were entirely free and the incidence of reactors in all dairy cattle tested in the Suva district had fallen to 0·4 per cent. No clinical cases of tuberculosis were manifest among the reactors. At this stage, towards the end of 1937, the total number of dairies entirely free still remains at 20, but among 7 other dairies on the Suva register only 16 reactors have been found and in this year 200 more dairy cattle were tested in Suva than was the case in 1935. It is seen that the number of reactors is slightly more than in 1935. This is accounted for in that a difficult situation occurs which has not yet been overcome since it is still necessary for several dairy farmers to send dry stock away from their dairy farms to remote pastures, otherwise there would be serious overstocking on the dairy premises. It is difficult to ensure that these cattle remain in isolation during these periods. In practice probably they do not and contact with untuberculin tested cattle takes place. Where odd reactors occur in herds previously free, it is usually found that the above conditions exist, infection having occurred whilst dry cows have been pastured elsewhere than on the registered dairy premises.

In the Public Health Regulations published in May of this year, provision is made for the extension of the tuberculin test to all registered dairies throughout the Colony. The application of this provision must be a gradual process.

It is realised that the individual farmer or the dairy industry as a whole would not be able to stand up to an sudden large loss of milking cows which would almost certainly occur were the Regulations to be at once rigidly enforced. It is envisaged therefore that the eradication of tuberculosis from these outside dairies will be a gradual process leading to almost complete eradication at the end of five years. It is hoped that this will be accomplished without any great financial loss to the farmer or retardation of the progress of the dairying industry. It must be understood by dairy farmers that the officers of the Agricultural Department, to whom this work is entrusted, aim to accomplish the task with as little inconvenience and loss to the farmers as is possible, and the co-operation of all dairy farmers is therefore sought.

### INFECTIOUS KERATITIS.

This disease of cattle and sheep continues to cause a certain amount of annoyance to stock owners. The disease is manifest in its severe stages by an ulceration of the centre of the glassy front of the eye, the ulcerating area being surrounded by a milky zone of opacity. The animal at this stage is temporarily blind. On the appearance of this disease on a farm, steps should be taken to isolate affected animals, since it is definitely contagious. At the same time treatment should be adopted. Many different medicaments have been found effective in the treatment of the disease; some of these are as follows:—

(1) The instillation into the eye of a small quantity of ½ per cent zinc sulphate solution.
(2) The application within the eyelid of a pea-sized portion of yellow oxide of mercury ointment of 2 per cent strength.
(3) The blowing into the eye of an antiseptic powder such as calomel in finely divided state or equal parts of boric acid and iodoform.

In spite of the very severe injury sustained by the cornea (glassy portion) of the eye during this disease, it is remarkable that complete loss of sight seldom occurs. One can hope to bring about reasonable healing in most cases of the disease. It is very rare for an animal which has been cared for whilst so afflicted to lose the sight of both eyes, whilst the loss of sight in one eye would not occur in more than 5 per cent. of cases.

Bacteria are responsible for the severe inflamation that occurs and infection may be spread from calf to calf by contact or through the agency of flies.

### CONTAGIOUS ABORTION.

No fresh outbreaks of contagious abortion have been reported during the year and the position relating to the control of this disease in Fiji must be considered very satisfactory. On those dairy farms also where the disease has been known to occur for some time the incidence has been becoming less so that during this year few if any farms have suffered any great loss.

It is well known that herds infected with this disease tend to develop a high herd-resistance to it so that few cases of abortion are met with in adult cows. In these herds, however, it is usually expected that some cases of abortion will occur among heifers.

For several years prior to 1937 the Department of Agriculture has been carrying out innoculations of non-pregnant heifers with live-abortion vaccine in a large herd where previously the number of abortions had assumed large proportions. According to information available in the Department of Agriculture, 18 per cent. of abortions was experienced at one period. During

this year the incidence has fallen so low that the proprietor has not considered it worth while to have the innoculations continued. Whether he is wise or not in this decision remains to be seen, but the results of the next few years are awaited with interest.

Abortion in the heifers which were innoculated with a live vaccine have been very few. This indicates that the introduction of these living abortion bacilli by the subcutaneous route into the body of these heifers has not proved harmful. The evidence is strong that the procedure has materially helped to reduce the incidence of the disease amongst these animals.

### EPHEMERAL FEVER OF CATTLE IN AUSTRALIA.

Those who have in mind the importation of cattle into Fiji will be interested to know the present position relating to Ephemeral Fever (Three-Day Sickness) of cattle in Australia. The Department of Agriculture has been in frequent communication with the Veterinary authorities in Australia relative to this complaint and the possibility of removing the embargo on cattle from that country. During the winter months the disease became greatly lessened in its incidence so that no records of its appearance in Victoria have been received for some time whilst in New South Wales very few cases have occurred. It is feared, however, that with the onset of warm weather there will be a recrudescence of the disease and until sufficient time has elapsed to see what happens in the summer months, it is not deemed advisable to remove the embargo.

### STERILIZERS FOR DAIRY FARMS.

The new Public Health Regulations published in May require that all dairy farms shall be registered. To qualify for registration a minimum standard of sanitation and equipment to the satisfaction of the Inspector is demanded. One of the articles of equipment which an Inspector will demand is the provision of arrangements for providing hot water and the means of scalding utensils. The most primitive arrangement is the kerosene can for boiling water. Better than this is the standard 12-gallon laundry copper for the production of boiling water. To boil 12 gallons of water, however, is a long process requiring a considerable amount of firewood.

The attention of dairy farmers is drawn to the fact that there are now sterilizers for dairy farms on the market which makes the production of boiling water and steam for sterilization on the farm an easy matter. These sterilizers may be fired in some cases by wood and in others by crude oil whilse some are adapted for either fuel. Large quantities of water may be rapidly boiled in the apparatus and in addition it is possible to utilize superheated steam in a suitable cabinet, such as an inverted barrel, for the steam sterilizatlon of various utensils. The use of this sterilizer is a distinct advancement in dairy hygiene.

In constructing new dairy premises or in repairing old ones, the installation of a sterilizer is urged on farmers. In addition to the undoubted improvement in dairy sanitation which follows the installation of the apparatus, it removes one of the chief sources of drudgery on dairy farms and thus tends to make the life of a dairy farmer more congenial. Particulars can be obtained on application to the Department of Agriculture.

### DERMATOMYCOSIS IN DOGS.

The term mange is used to signify that class of disease of the skin of animals caused by infection with parasites of the mite family. Dermatomycosis is the scientific name for the disease caused by the infection of the skin with parasitic fungus. The term " ringworm " is often used when referring to

dermatomycosis. Ringworm in the dog, however, does not very closely simulate typical ringworm as seen in other animals. To a casual observer, however, it very closely resembles mange. It is characterised by reddening of the skin and itching. At times small red pimples occur and there is a general scurfiness. Loss of hair occurs over the infected areas. The base of the tail, along the back and sides of the dog are the sites most commonly affected.

In the laboratory, dermatomycosis must be differentiated from mange. This is done by finding the fungus spores affecting the roots of the hairs in the one case or finding the mange mite parasite in the other. Experience in Fiji indicates that mange is a much more easy condition to deal with than so-called "ringworm."

Dogs infected either with mange or with ringworm should be clipped closely. This is best done with barber's hairclippers. The animal should then receive a bath in Potassa sulphurata solution using one oz. to the gallon of water. This solution should be allowed to dry on the dog.

The applications which may subsequently be made to the skin of the dog with a view to curing the condition are many. A cure however, cannot be guaranteed with any one of them. In some dogs one particular type of medicament produces good results, and fails in another. Among the applications which may be tried are:—Tincture of iodine; saturated solution of salicylic acid in iodine on very small areas; salicylic acid in methylated spirits; Friars Balsam on limited areas; sulphur ointment; zinc oxide and several proprietary ointments.

These notes may be of use to country residents where easy reference to a veterinary surgeon is not possible.

## HERD-TESTING.

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Government Veterinary Officer.

HERD-TESTING in Fiji has not been given the prominence its importance undoubtedly warrants. In most dairying countries, competition for the world dairy products markets is so keen that every measure for lowering production costs and increasing the yield has to be adopted or the industry languishes.

Herd-testing indicates to the farmer his low-production cows and the wise man will at the earliest moment eliminate these animals from his herd. Further, he will be warned by this test that the progeny of these low-production cows will probably be unprofitable to him and hence he will not retain such stock for milk purposes. On the other hand he can, by the selection of heifers from his best producers, build up his herd to that stage when all the members are individual profit makers.

In Fiji, where the dairying industry had started practically from scratch after the War, it had first been necessary to build up the numbers of milking cattle. Most owners adopted the principle that it was better to have a herd sufficient in numbers to use up the available pastures, even if a considerable number of these animals were low butter-fat producers. The disastrous floods and hurricanes of 1929 and 1931, by causing considerable

losses amongst dairy cattle further retarded the time when the numbers of dairy cattle were sufficient to satisfy the demands of the dairying industry.

A protective duty on butter and a more recently imposed duty on certain vegetable oils further widened the local market for butter-fat, called for a greater consumption of butter-fat and retarded the time when the number of cows in the dairy industry was sufficient for local demands.

At the present moment, local demands are practically satisfied and any further increase in butter-fat production will have to be absorbed on the open markets of the world against competition from other butter-producing countries. It is doubtful if, with the present per head yield of butter-fat, butter could be economically produced at world parity rates.

It would therefore seem desirable that the regular testing for butter-fat production should now be undertaken by Fiji dairy farmers for the following reasons:—

Regular testing indicates the most productive cows. The test should be continued over the lactation period as this gives a true indication of the cow's worth; spasmodic testing only indicates yield at the time of test and this may vary considerably from different causes.

Testing of the progeny of cows indicates those cows which are transmitting their producing qualities to their stock. The same applies to the progeny of the bull. It is a known fact that some bulls with excellent butter-fat backing do not transmit their qualities to their progeny and where it is found that the progeny of good cows are regularly showing a less butter-fat production than their dams, it is a good policy to replace such bulls.

Herd-testing gives the owner a more thorough knowledge of his herd. His interest naturally becomes keener and he will give greater care and attention to his better cows. If, for instance, a cow which he knows to be a good producer has a poor lactation period through some illness, he will endeavour to get her fit for the next lactation period instead of getting rid of her as he may be tempted to do if she was an unknown quantity as far as yield is concerned.

In the selection of calves for ultimate inclusion in the milking herd, the dairy farmer can be largely guided by the knowledge he has gained from their mothers. He will not have to rear large numbers of calves in the hope that a fair percentage at least will turn out to be productive animals. Also, by fewer numbers the productivity of which is fairly certain to be good, the farmer is enabled to give greater care to them in matters of feeding, hygiene and general husbandry. He is thus assured that these animals have a better chance of reaching a healthy and well grown maturity than would be the case where he is obliged to keep large numbers improperly cared for.

Where test-records are regularly kept, the farmer often gains and records other useful information apart from that directly obtained from such tests. For instance, he learns the average milking periods of each and the number of services required for each cow. Records of illness, abnormalities in calving or injuries may be made. Sudden decreases in yield of either milk or butter-fat will be more readily noticed and investigation into the cause of these can be made.

Thus not only does herd-testing give general useful information in itself but it also teaches the farmer to be more observant, to take a keener interest in his herd, and, by knowledge gained, uplift the general husbandry of the herd with subsequent profit to the owner.

## THE INTERNATIONAL SUGAR AGREEMENT.

By
A. B. ACKLAND,
Inspector of Produce.

A FIVE years agreement to regulate the production and marketing of sugar was signed in London on the 6th May, 1937, by the representatives of 21 producing and consuming nations, covering about 90 per cent. of the world's output.

The agreement was negotiated at a conference summoned in the name of the Bureau of the World Monetary and Economic Conference of 1933, and was signed by delegates of and on behalf of the following Governments:—

| | |
|---|---|
| The Union of South Africa. | Haiti. |
| The Commonwealth of Australia. | Hungary. |
| Brazil. | India. |
| Belgium. | Peru. |
| The United Kingdom of Great Britain and Northern Ireland. | The Netherlands. |
| | Poland. |
| China. | Portugal. |
| The Republic of Cuba. | Jugoslavia. |
| Czechoslovakia. | The Dominican Republic. |
| The Union of Soviet Socialist Republics. | France. |
| The United States of America. | Germany. |

The most salient features of the agreement are as follows:—

In the preamble, the contracting parties declare that the agreement has been reached with a view to establishing and maintaining an orderly relationship between the supply and demand for sugar in the world market; they call attention to the fact that the present situation of the sugar market renders it possible and necessary for the Governments concerned to collaborate to this end; and they declare that they have borne in mind the principle that any International Agreement for the regulation of production and marketing should be equitable both to producers and consumers.

The agreement defines the quota year as the period from the 1st September to the 31st August, and lays down that the contracting Governments shall take all the legislative or administrative measures necessary for the execution of the agreement. Indications are given regarding the rules which it would be desirable to apply to agrarian policy and to State assistance to the sugar industry. It is agreed that favourable consideration should be given to all proposals having for their objective the reduction of the disproportion of fiscal burdens on sugar; the encouragement of increased consumption of sugar; the checking of abuses resulting from the substitution of certain substances for sugar, and the search for new uses for sugar. It is provided that a Council, which it is proposed should be formed, shall make a study of these various subjects and that the Governments shall supply certain statistics and information requested by the Council.

Chapter III contains the obligations entered into by countries not exporting to the free market, *i.e.*, a place where sugar may be sold in open competition. The United States of America will continue to import from the free market at least as much as at present. The Philippines will not export to the free market, so long as their present arrangement with the United States remains in force, except that a small share in any increase in the free market requirements is reserved fro them.

The United Kingdom will maintain its present legislation regulating sugar production designed to limit the annual production of sugar in Great Britain

to a standard quantity of 560,000 long tons of white sugar (approximately 618,000 metric tons raw value). It is expected, however, that for the sugar year 1937–38 this maximum will not be reached.

The British Colonies will limit their total exports to a basic figure of 965,254 metric tons (950,000 long tons) per quota year.

Australia will limit her exports to 406,423 metric tons (400,000 long tons). The Union of South Africa will limit them to 209,000 metric tons (230,000 short tons). India will prohibit exports by sea elsewhere than to Burma.

If consumption increases in the parts of the British Empire which are at present importers, the British Dominions and Colonies and the United Kingdom producers shall obtain a share in this increase proportionate to that which they have in present requirements, any surplus in such increase to be reserved for exporters to the free market. Australia and the Union of South Africa have undertaken to leave their share of the increases available to the free market in 1937–38.

The Government of China will use its best endeavours to the end that the sugar import requirements of the Chinese market shall not decrease, and if possible shall increase, during the period of the present Agreement.

The Netherlands undertake not to export to the free market sugar produced on their territory whether in Europe or in Dutch Guiana.

Chapter IV fixes the export quotas for the free market allotted to the difierent contracting countries. These basic quotas are as follows:—

| | *Metric tons.* |
|---|---|
| Belgium (including Belgian Congo) .. .. .. .. | 20,000 |
| Brazil .. .. .. .. .. .. .. .. | 60,000 |
| Cuba .. .. .. .. .. .. .. .. | 940,000 |
| Czechoslovakia .. .. .. .. .. .. .. | 250,000 |
| Dominican Republic .. .. .. .. .. .. | 400,000 |
| Germany .. .. .. .. .. .. .. .. | 120,000 |
| Haiti .. .. .. .. .. .. .. .. | 32,500 |
| Hungary .. .. .. .. .. .. .. .. | 40,000 |
| Netherlands (including overseas territories) .. .. .. | 1,050,000 |
| Portugal (including overseas possessions) .. .. .. | 30,000 |
| Peru .. .. .. .. .. .. .. .. | 330,00 |
| Poland .. .. .. .. .. .. .. .. | 120,000 |
| Union of Soviet Socialist Republics (excluding exports to Mongolia, Tanna Tuva and Sin-Kiang) .. .. .. | 230,000 |

Czechoslovakia will receive the following extra allotments for the year beginning September: 1937, 90,000 metric tons; 1938, 60,000 metric tons; 1939, 25,000 metric tons.

An export quota of 47,500 tons is placed in reserve, to be placed at the disposal of certain countries should need arise.

Jugoslavia shall have a claim on the reserve up to 10,000 tons during each year of the Agreement. France will be entitled to the remainder if her home or Colonial production exceeds her consumption.

Further, it is noted that the Governments of certain countries have given notice that during the quota year beginning September,1st 1937, they will not make use of certain parts of their export quotas, viz:—Belgium, 5,000 tons; Germany, 70,000 tons; Hungary, 20,000 tons; Poland, 20,000 tons; Union of Soviet Socialist Republics, 11,500 tons.

The French Government has, moreover, given notice that during the said year the reserve quota may be reduced by 22,500 metric tons.

In addition, in the years 1937–38 and 1938–39, the International Sugar

Council may reduce all the effective quotas as set out above by a uniform per centage not exceeding 5 per cent. if it thinks it necessary. Reductions may be made in later years if all the Governments concerned agree. On the other hand, if the quotas are inadequate at any time the Council may (acting by three-fifths majority) allot additional quotas pro rata to any extent it thinks fit. Provision is made for the Executive Committee to consider as a matter of urgency and consult the Council by telegraph if any sudden shortage or threat of an undue rise in price should occur.

Chapter V contains the provisions relating to stocks which have taken into account considerations of two kinds; on the one hand the contracting Governments have fully realised that due regard must be had to the necessity of maintaining adequate reserve supplies to meet unexpected demands and on the other they have agreed that it is undesirable that excessive stocks of sugar should be allowed to accumulate and weigh on the market. Those contracting Governments, to which export quotas have been or may be allotted, have undertaken so to regulate their production that their stocks shall not exceed respectively, on a date to be fixed each year by mutual agreement, an amount equal to 25 per cent. of their annual production. Nevertheless, the Council may authorise certain exceptions and moreover, special provisions have been made with regard to the stocks of the Republic of Cuba, the Netherlands, East Indies and Hungary. It is agreed that sugar production shall be regulated on the territory of cane-producing countries, apart from special adverse conditions, so that stocks shall equal on a fixed date in each year, an amount not less than 10 per cent of the export quota.

Chapter VI provides that the Agreement shall be under the administration of an International Sugar Council composed of representatives of all Contracting Governments, and by an Executive Committee of nine members. The seat of the Council and the Committee will be in London; a Secretariat will also be set up.

This chapter also lays down the powers and duties of these various organisations, indicates the conditions under which they will be summoned and budgeting arrangements, voting arrangements, &c. It is further provided that the Executive Committee shall include three representatives of the Importing Countries, three of cane-producing countries and three of beet-growing countries. The complete composition of this Committee is also determined.

Finally, Chapter VII contains various provisions particularly regarding the territories to which the Agreement shall apply, procedure in cases of infringement, procedure for cases in which the attainment of its object is being hindered by countries not parties thereto, conditions of ratification entry into force, duration (five years from the date of entry into force) denunciation and withdrawal in specified conditions.

The following communiqué, giving particulars of increases in the Colonial sugar quotas for 1937–38, was released for publication by the Colonial Office on June 18th.

For purposes of comparison we have placed the peak exports and basic quotas, as originally proposed, alongside the revised figures.

1. The Secretary of State for the Colonies, after full consideration of the various representations made to him, has decided the allocation of sugar quotas for 1937–38, on the unanimous recommendation of the Permanent Advisory Committee of Colonial Sugar Producers.

2. The basic quota for the Colonial Empire is 950,000 long tons. Over and above this figure the Colonial Empire is entitled to a proportionate

share of any increase in Empire consumption in 1937-38 over that in the current year. Further, the United Kingdom has agreed that its own proportionate share of such increase may, for 1937-38, be enjoyed by the Colonial Empire. For present purposes, the increase has been estimated at 3 per cent. which, with the inclusion of the United Kingdom's share, results in an addition of 47,000 tons to the Colonial Quota thus making a total of 997,000 tons available. The figure of 47,000 must be regarded as provisional pending compliance with the formalities set out in Article 14 (*b*) of the International Agreement.

3. With the exception of the three East African teritories, Kenya, Uganda and Tanganyika, in regard to which a somewhat different basis was adopted, each Dependency was allocated to begin with its previous maximum exports up to and including 1936, less 7 per cent. The total of the quotas so allotted was 948,326 tons. The recommendation of the Committee was that the balance should be allocated among all the Dependencies other than the East African territories roughly on a basis of three-fifths pro rata and two-fifths to meet special cases. In considering the special cases the Committee took into account the whole social and economic position of each Dependency.

4. The recommendation of the Committee was that the quotas for 1937-38 (in tons of 2,240 lb) should be as follows:—

| | Quotas for 1937-38. | Peak Exports. | Proposed Basic Quota. |
|---|---|---|---|
| Barbados. .. .. | 114,000 | 119,685 | 111,307 |
| British Guiana.. .. | 170,000 | 176,500 | 164,145 |
| Fiji .. .. .. | 135,000 | 140,864 | 131,004 |
| Jamaica.. .. .. | 86,000 | 77,733 | 72,292 |
| Leeward Islands .. | 53,500 | 49,670 | 46,193 |
| Mauritius .. .. | 263,000 | 274,783 | 255,548 |
| Trinidad . .. .. | 138,000 | 142,671 | 132,684 |
| Windward Islands .. | 10,500 | 8,781 | 8,167 |
| East Africa .. .. | 27,000 | 29,017 | 26,986 |
| | 997,000 | 1,019,704 | 948,326 |

5. The Committee added a rider to their recommendation that British Guiana and Fiji should have a prior claim to consideration if any other Colony is unable to fill its quota.

6. The Secretary of State for the Colonies has considered the recommendation most carefully and has decided to accept it without modification. He fully appreciates that individual Dependencies may have hoped that the quota allocated to them individually would be larger; but he is satisfied that due weight has been given to all the various factors involved and to the representations which have been made to him and that the allocation is as fair as possible. It will be understood that quotas are only applicable to 1937-38 and that those for following years will be a matter for further consideration.

7. The question how the quotas for each Colony are to be divided among individual producers is left for local decision but it is presumed that the basis will be past production with whatever allowances may be necessary to meet recent developments. The Secretary of State considers it important that so far as possible special consideration should be given to the position of small cane-farmers.

8. As stated, a somewhat different basis has been adopted in calculating the quota of the East African territories. This was necessitated by the

special circumstances affecting them. The quota of 27,000 tons allotted to them will assure the group an increase of about 50 per cent. over its previous maximum exports. The division of the quota between the three territories, Kenya, Uganda and Tanganyika is to be left in the first instance to East Africa itself and the precise position of the individual territories cannot therefore at present be stated.

It will be noted that Antigua and St. Kitts; St. Lucia and St. Vincent; Kenya, Uganda and Tangayinka, are treated as single units as the Leeward Islands, the Windward Islands and East Africa respectively.

## GENERAL NOTES.

### WAIDOI GRASS (*Ischæmum aristatum* Linn.).

Travellers on the recently opened Navua road may have noticed the thick mat of straggling grass which occurs almost as a pure stand among the rubber trees in the old Waidoi plantation. This grass has always intrigued the writer who first observed it many years ago when visiting Waidoi. Identification of a plant without the presence of the flowering head is a difficult matter and, until this year, visits to the plantation never coincided with the flowering of the plant, and in fact, it was thought that the grass was numbered amongst the few species which do not flower.

On 25th June this year, on passing through the plantation, the grass was noticed to be flowering. Specimens of the flowering head were taken and brought back to the office where they were identified as *Ischæmum aristatum* Linn.

The grass is interesting in that for many years it has withstood the invasion of other plants and grasses and in this respect one would expcet it to be a promising grass from a grazier's point of view. In its habit of growth it somewhat resembles Para grass but the writer is of opinion that the grass is not as good either in palatability or nutritive quality as Para grass, and it is therefore not recommended to be sown in preference to the latter grass.

### MARAINA GRASS.

Several enquiries have been received by the Department of Agriculture from country residents requesting information as to the identity and habit of the grass known to the Indian residents as Maraina grass. The grass has been identified as *Ischæmum rugosum*, Salisb., and is cited as one of the three major weeds of rice fields in Ceylon. It is tropical in its distribution. In Fiji it is a common pest of wet land rice-growing areas of the Lower Rewa River, Viti Levu and the mouth of the Dreketi River, Vanua Levu. Its eradication should receive the early consideration and attention of all rice-growers.

The grass in its young state is in general appearance identical with young seedling rice and is readily mistaken for it, hence one of the great difficulties in securing early and rapid eradication lies in this resemblance. Further, its seeding time usually concides with the harvest time of rice so that unless the paddy is carefully and thoroughly cleaned, resowing takes place each season when preparing and sowing the nursery beds. The following suggestions are made to assist in affecting control over this seed of wet rice fields. Generally it may be said that the area of rice grown by each Indian is small

and thus allows for a more intensive cultivation and attention of the crop during its period of growth, and, since the grass favours wet land, hand-pulling of it is easy.

The general custom of neglecting the ploughing after preparation of such rice land until a month or two before the next planting season gives the "Maraina" seed opportunities for germination, growth and possible re-seeding of the land before planting time.

Control may therefore be possible along the following lines:—

1. By burning all refuse as soon as possible after harvest and by ploughing. The burning would tend to destroy seed left in the rice straw, would hasten germination of seed lightly burnt and the ploughing would, if carried out as deep as possible, bury the seed and destroy it.

The next ploughing would be carried out at the usual preparation time or sooner, as circumstances indicated, to prevent the seeding of any grass which may have germinated and grown in the interval between ploughing.

When preparation is completed, careful hand-weeding should be carried out before planting commences, this would control both volunteer rice as well as Maraina grass.

Careful weeding a week or two after planting should rid the crop of most of the weed; and identification should be easy for the reason that it is customary to cut back the new planted rice to about 6 inches, the cut leaves persisting to identify the rice as against the grass subsequent weedings.

2. All paddy should be carefully winnowed to remove all foreign matter and seeds. Such careful screening would obviate the resowing of Maraina when preparing the sowing of the rice nursery bed.

3. Ensure that only pure paddy seed is used.

4. If the rice field is divided into four sections and a section planted at monthly intervals, (each section being carefully weeded both before and after preparation and planting), the weed should be brought under control, particularly as the planting season, which extends roughly from October to March, covers the normal germination and seeding time of Maraina. Finally, it should be remembered that a good farmer is a clean farmer and land which is well cultivated and tended usually has all weeds under control.

—C.R.T.

## THE DWARF COCONUT.

The Malayan dwarf palm has been successfully grown in Taveuni by Mr. E. Duncan, who recently broadcast his opinions by courtesy of the local Wireless Broadcasting Station.

Mr. Duncan's opinions are substantiated by his actual results and by the writer's personal experience in Malaya.

The Malayan dwarf coconut occurs as three types, differing in the coloration of the midribs of the leaves of the young shoots, and of the rind of the ripening fruit.

Malayan experience indicates that of the three types green, red and yellow, the green dwarf is the most robust in growth, most resistant to adverse conditions, productive of the best quality copra and of the largest nuts.

On the whole, the dwarf palm is not so hardy as the tall palm as regards changes in soil conditions, &c., but the green type has proved eminently satisfactory under ordinary plantation conditions and is definitely superior to the red yellow types in its copra-producing characters, and on the average it produces the larger nut and is thus preferable for handling.

As regards the commercial characters of the dwarf coconut with the ordinary tall types, Mr. E. Duncan's experience confirms Malayan experience, that

under good average conditions the yields of copra per acre from dwarf coconuts exceeds those from the ordinary tall types.

The reason for this is due to the density of planting, since under local conditions, up to 133 dwarf palms may be planted per acre according to conditions, as against 50 to 80 of the ordinary tall palms. A planting distance of 18 feet by 18 feet is recommended for dwarfs in this Colony, giving 133 palms per acre, if square planting is adopted.

This planting distance, under existing conditions where soils are rich, where implemental cultivation is rarely possible, and where weed growth is prolific, should quickly keep weed growth in check and enable the palms to begin bearing after three years compared with 5 to 6 years for talls. The dwarfs should be in full bearing after 6 years as against 12 years for talls and approximately 6,000 dwarf nuts produce one ton of copra under Taveuni conditions where also yields per acre have exceeded this figure.

## SOYA BEAN.

The chief competitors of coconut oil in the warld's markets are soya bean oil, palm oil, whale oil, cotton seed oil, linseed oil, groundnut oil, lard and tallow. There are also a number of less important oils such as maize oil which has shown considerable development in United States of America where 80,000 bushels of maize were used for this purpose in 1934.

The main use of most of the above oils include margarine, lard substitutes, edible and cooking oils, soaps, glycerine, paints, varnish, &c.

The growth of the soya bean industry is illustrated by production in United States of America where production increased from 160,000 tons in 1926 to over 500,000 tons in 1933 and imports into England and Europe generally have greatly expanded since 1930. In 1936, the world production of soya bean amounted to 10,332,000 tons.

Soya bean oil, as a result of new processes, is now a direct competitor with coconut oil. Similarly other oils, previously considered unsuitable for margarine or other purposes, can now be substituted for coconut oil as a result of advances in chemical treatment including hydrogenation, hardening, neutralisation and deodorization.

Hence, it is now possible to substitute one oil for another in manufacturing processes and thus manufacturers can quickly take advantage of price changes in their favour to adopt the cheaper oils to their immediate needs.

Thus coconut oil has now many more competitors than it had 15-20 years ago and therefore it behoves all producers to seek every possible means of affecting economies in their costs of production and marketing and of striving to gain the best prices by producing an improved product and by co-operation in marketing.

## FORESTRY OFFICER.

At a recent meeting of the Legislative Council it was agreed that a fully-trained Forest Officer with several years of experience should be seconded to Fiji from Malaya in order to inaugurate forest work in this Colony. This is a sound progressive step and once practical field work is properly organised by a full time Forest Officer it should then be possible for continuity of effort to be assured by gradually building up the requisite staff.

The value of our forests is considerable but their value can be greatly enhanced by a progressive and continuous programme of sylviculture and protection of selected areas.

Hence the recommendations of the Legislative Council in this matter is hailed with satisfaction.

—H.W.J.

## CULTIVATION OF BETEL LEAF IN FIJI.

By
SILAS RAM JAN, Indian Field Assistant, Western Division.

THE Leaf of the Betel vine (*Piper betle*) called " Pan " in Hindi, is used fairly commonly as a masticatory among some sections of the Indian community in Fiji. It is in the nature of a delicacy and is habit-forming. Commonly the fresh leaf is sprinkled with lime, a small piece of Betel-nut (*Areca catechu*) is added together with such other spices as suit the taste of the addict. Such spices impart an additional flavour and usually are one or more of the following:—Cloves, nutmeg, cardamom, tobacco or cinnamon. Regular use stains the lips, teeth and gums a bright red.

The Madrasees and Gujratis commonly chew betel or " Pan " in India and it is adopted to a certain extent in Fiji where it is customary to present " Pan " as a form of light refreshment to important personage or to visitors to the house.

The vendor of " Pan " is called " Tamboli."

It is used in the Indian marriage ceremony. The " Pan " is prepared by the bride and is given by her mother to the bridegroom as a token that each will share the other's troubles and hardships and that they will not be separated while they both live.

The successful cultivation of the plant requires much care and attention. It must be protected from excessive sun, wind and rain and is therefore usually grown under " green house " conditions. Considerable work is entailed in its production and the writer knows of four farmers who make a living from not more than two square chains of the vine.

A deep rich porous soil is required. Large quantities of well-rotted compost are dug in and thoroughly mixed with the soil. The plot should be properly drained so that the moisture can move freely. It is important that the right amount of water is available as either too much or too little will prevent the vigorous growth of the plant which is so desirable.

Planting material consists of cuttings which are planted 6 to 8 inches apart and are allowed to grow and cover the ground. Staking of the vines would probably produce better results but it is not commonly practiced here, though it is in the East.

In Fiji the " green house " covering the " betel " garden is built of coconut leaves, the top and sides being covered in. The plants are usually 4 months old before picking commences but thereafter pickings can be made weekly. When the top leaf is 4 to 4½ inches long the second and third leaves are also ready. The leaves are plucked and tied into small bundles of about two dozen leaves. These bundles are sold in the bazaars at three pence each and in Indian centres prove a profitable side line for the small agriculturist.

## THE SHOW.

THE thirteenth Annual Show conducted by the Fiji Show Association was held in Number 1 and the Produce Inspection sheds on the 4th October.

In spite of showery weather the show was a decided success and attracted a larger number of visitors than in the previous year.

As in past years the Department of Agriculture put up a comprehensive exhibit, the chief features being a display of vegetables, including cauliflowers produced on Kadavu, rhubarb, turnips, leeks, carrots, lettuce, &c., and a standard type of small copra drier. An exhibit of cotton, seed cotton, cotton seed and lint baled for export attracted attention to a non-perishable crop suitable for cultivation by small holders which is gradually taking its place in the agricultural production of the Colony.

Other exhibits included tobacco, maize, soya beans, broom millet and brooms made locally therefrom, ginger, hemp, rice and a display of ornamental and economic plants.

The Veterinary Division exhibited specimens of pasture plants of Fiji, specimens of pathological conditions occurring in animals and samples of concentrate feeding stuffs. Charts illustrating the progress of tuberculosis eradication and the development of the dairy industry set out clearly the position in relation to these subjects. In the poultry section a house and run suitable for raising chickens was demonstrated.

The exhibits in the Division of Entomology were primarily designed to show the beneficial insects intoduced into the Colony from 1913 till the present year. A large scale map showed the countries from which the parasites originated, Java being seen to be the most exploited territory. Two examples of biological control in operation were on view, viz., the Mexician plant bug *Teleonemia*, introduced in 1928, shown feeding on the lantana plant and two Hymenopterous parasites of the fruit-flies: both of these were, like *Teleonemia*, imported from Hawaii though they originally came from India (*Dirhinus*) and Africa (*Tetrastichus*). These wasps attack respectively the pupæ and larvæ of fruit-flies (*Chætodacus*) and were seen ovipositing in their prey which were feeding on guava fruits.

The agricultural and vegetable competative sections provided an excellent display of produce.

Enteries were numerous in the class for kiln-dried copra prepared by Fijians in the standardised hot air driers and some very fine samples were seen. The Fijians again supported these sections by providing the bulk of the entries and one man, Rusiate Tuisopipi of Naimalavau, Nakelo, Tailevu, received prize money to the extent of £5 12s. 6d.

Mr. J. Barker provided a good display of vegetables and his entry was easily the best in that class.

Two Indian farmers entered in the class for the display of agricultural products grown by an Indian farmer.

Colo East and Macuata Provinces put up provincial agricultural and industrial exhibits and although the Colo East display, organised by Native Field Assistant Joni Roko, took the prize, the Macuata people are to be congratulated on their exhibit.

## OBITUARY.

F. W. URICH, late Government Entomologist, Trinidad.

IT is with the deepest regret that we have read in recent West Indian papers of the passing of Mr. F. W. Urich, formerly Government Entomologist, Trinidad, and more recently, Assistant Professor of Entomology at the Imperial College of Tropical Agriculture. Although not directly connected with this Colony, the work of this scientist has been of particular value to Fiji, as it was due to his investigations, carried out at the request of the writer, which led to the discovery of the thrips which now bears his name (*Liothrips uricih*) and whose introduction into Fiji has been so successful in the control of the curse, *Clidemia hirta*.

It was also a note by this same officer, on the control of the transparent scale *Aspidiotus destructor* in Trinidad by certain ladybirds, which led to the equally successful introduction of *Cryptognatha nodiceps* into Fiji.

Mr. Urich was a keen all-round naturalist, interested in all forms of life and with a profound fund of local knowledge, which he always freely placed at the disposal of other workers. The writer has many pleasant memories of his kindly assistance and genial personality and his passing will be keenly felt by all those who have had the privilege to have been associated with him.

—H.W.S.

## ABSTRACT.

THE MEAT AND LIVE STOCK INQUIRY COMMITTEE REPORT, KENYA (SUMMARY).

*East African Agricultural Journal*, Vol. III., No. 1., p. 21.

IN settled areas, the general trend in farming is towards mixed farming instead of straight out crop-growing, due principally to the progress of the dairy industry. Dairying, however, is frequently carried out under ranching conditions, more suitable to beef raising than dairying but lack of beef markets, has forced the farmers into dairying.

Pig production has lagged behind the dairying industry. In 1922, there were 3·2 pigs for every 10 dairying cows, in 1934 the proportion was 1·87 pigs to 10 dairy cows, also little or no use of small flocks of sheep has been made. Lack of export markets has in both instances retarded the development of the industry.

Lack of adequate markets for slaughter also adversely affects the native reserves, an annual surplus of production over disposals results in overstocking with detriment both to the pastures and the stock themselves. Paradoxically, the situation appears to have been relieved by four years of drought and a severe epidemic of rinderpest. It is considered that many animals from such overstocked reserves will be fit for canning purposes only, but the removal of these lower grade animals would permit a general overhaul of grazing areas, the instigation of the quota system for different sections and the initiation of developmental scheme for the pastoral tribes.

Due to quarantine regulation against East African tropical diseases, the export of beef cattle on the hoof to neighbouring territories and the Mediterranean areas was impracticable.

Prospects of developing an export trade in canned beef and frozen or chilled beef were examined. It was considered that in the long run, any export trade must be based on beef with frozen pork, fat lambs, and poultry as sidelines. From investigation made in Southern Rhodesia, and advice received from representatives of a meat-exporting company, it was considered that a canning factory with a minimum capacity of 30,000 head had good prospects of success. It was further considered that there would be no difficulty in supplying 50,000 head for chilling or freezing. The committee considered that Kenya with its two rainy seasons was capable of maintaining beef cattle in condition throughout the year, a factor favourable to the production of chilled beef. It was thought that Kenya should aim at entering the highest class of the meat export trade, *i.e.*, the chilled meat trade of the London Market. It is the general opinion of authorities that certain areas are suitable for the production of chilled beef and many of the native breeds are of a suitable type for beef cattle.

The Committee considered that the maintenance of a small flock of sheep, on mixed farms was advisable as it assists in the retention of fertility of the soil and provides a profitable sideline.

Legislation for the control and development of the industry were recommended, with the establishment of a Meat Control Board. A suggestion was made that a levy on local sales of slaughter pigs be made, the accruing funds being used as a bounty for export sales.

In order to build up sufficient cattle, sheep and pigs of the requisite type to fulfil the demands of the expected trade, it was recommended that a sum of £3,000 annually be set aside for the purpose of providing assistance to farmers to purchase pure-bred stock, grants not to exceed half the cost of the animal at the purchaser's farm. For imported animals such grants should not exceed £50 for a bull, and £20 for a boar or ram. For locally purchased animals the maximum to be £25 and £5 respectively.

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